Single Aisle
TECHNICAL TRAINING MANUAL
T1+T2 (IAE V2500) (Lvl 2&3)
AIR CONDITIONING

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AIR CONDITIONING

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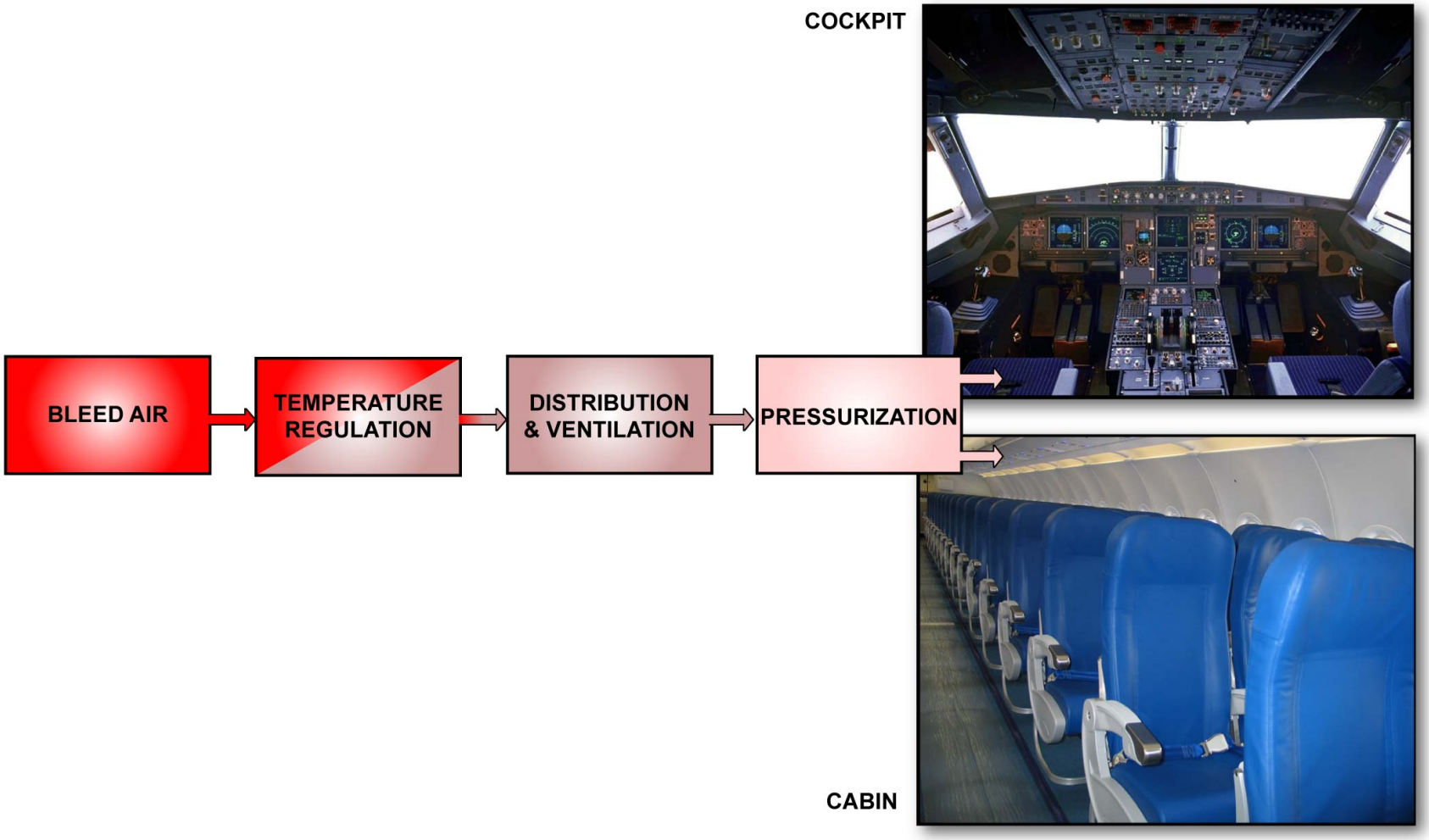
AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

SYSTEM OVERVIEW

The air conditioning system main function is to keep the air in the pressurized fuselage compartments at the correct pressure and temperature. In details, this system provides the following functions:
- cabin temperature control,
- pressurization control,
- avionics ventilation,
- cargo compartment ventilation & heating (optional).



SYSTEM OVERVIEW

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

SYSTEM OVERVIEW (continued)

CABIN TEMPERATURE CONTROL

The Single Aisle family has two air conditioning packs installed in the wing root area, forward of the landing gear bay. The packs supply conditioned air to the cabin for air conditioning, ventilation and pressurization. The primary component of each pack assembly is the air cycle machine.

Hot air from the pneumatic system is supplied to the pack through the pack Flow Control Valve (FCV). The FCV adjusts the flow rate through the pack and is the pack shut-off valve. During normal operation, the Air Conditioning System Controller (ACSC) calculates the flow mass demand and sets the flow control valve in the necessary reference position.

The pack temperature control system controls the pack outlet temperature and sets its maximum and minimum limits. The system includes two ACSCs. Each ACSC controls one pack. To control the pack outlet temperature, the ACSC modulates the BYPASS VALVE and the RAM-AIR INLET doors.

The packs supply the mixer unit. Three separate aircraft zones are supplied from the mixer unit:

- cockpit,
- forward cabin,
- aft cabin.

Two cabin recirculation fans are installed to reduce the bleed air demand and therefore save fuel. These fans establish a recirculation flow of air from the cabin zones to the mixer unit. In normal operation, there are no ECAM indications associated with the cabin fans.

The ACSC controls and monitors the temperature regulation system for the cabin zones. On the overhead AIR COND panel, the flight crew selects the desired individual compartment temperature.

The hot air system for cabin temperature control has a trim air Pressure Regulating Valve (PRV) and trim air valves controlled by the ACSC. For the zones in which warmer temperatures are necessary, the ACSC sends a signal to the related TRIM AIR VALVE to open. Hot air mixes with the Mixer Unit discharge air and the temperature increases.

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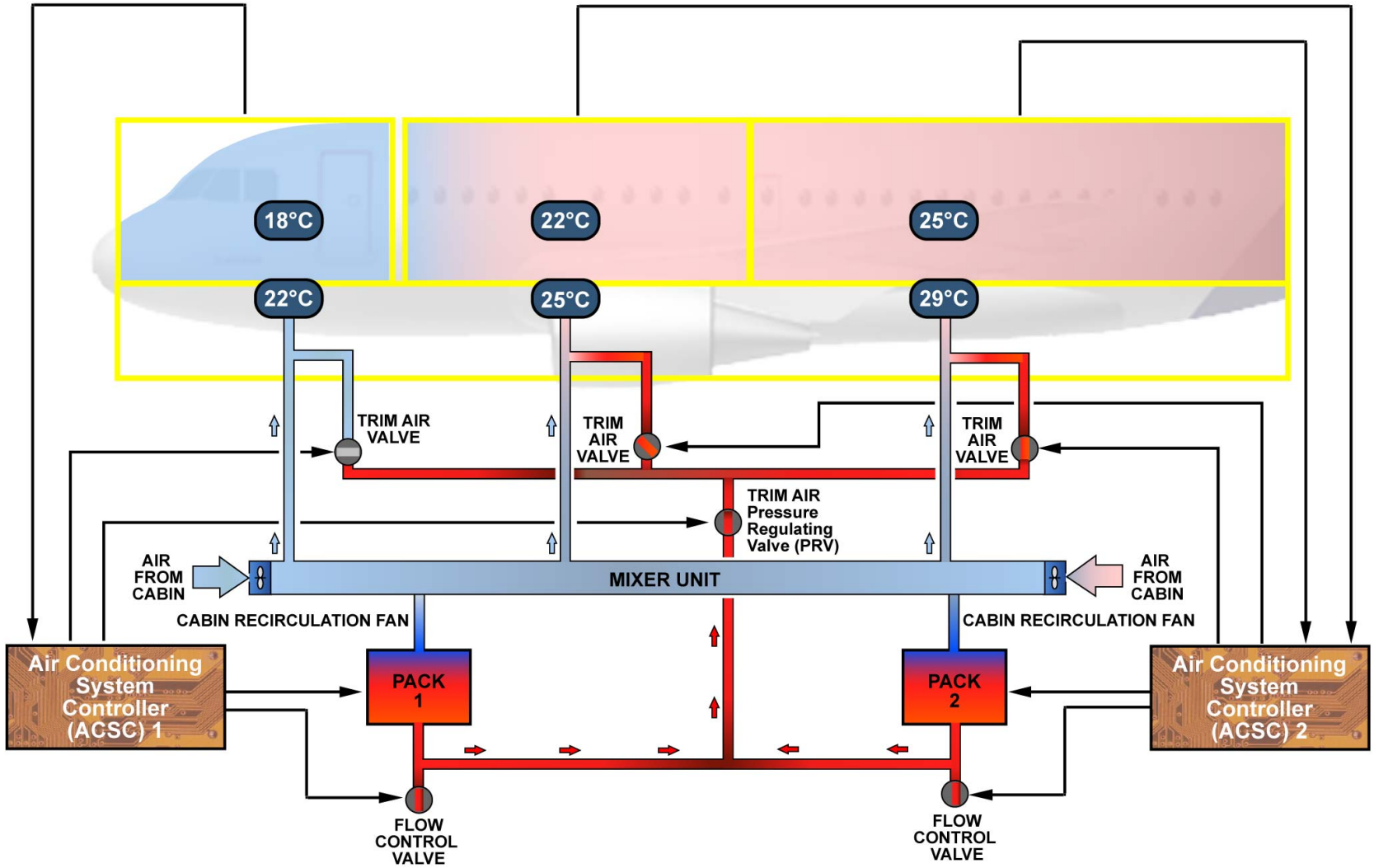

SYSTEM OVERVIEW - CABIN TEMPERATURE CONTROL

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

SYSTEM OVERVIEW (continued)

PRESSURIZATION CONTROL

The pressurization system on the Single Aisle family normally operates automatically to adjust the cabin altitude and rate of climb to ensure maximum passenger comfort and safety. The pressurized areas are:
- the cockpit,
- the avionics bay,
- the cabin,
- the cargo compartments.

The concept of the system is simple. Air is supplied from the air conditioning packs to the pressurized areas. An outflow valve is used to adjust the quantity of air that is released from the pressurized cabin.
Automatic control of the outflow valve is provided by two Cabin Pressure Controllers (CPCs). Each CPC controls one electric motor on the outflow valve assembly. The CPCs interface with other aircraft computers to optimize the pressurization / depressurization schedule.
There are two automatic pressurization systems. Each CPC and its electric motor make up one system. Only one system operates at a time with the other system acting as backup in case of a failure. The system in command will alternate each flight.
A third motor is installed for manual operation of the outflow valve in case both automatic systems fail.
To protect the fuselage against excessive cabin differential pressure, safety valves are installed on the rear pressure bulkhead. The safety valves also protect against negative differential pressure.
The Residual Pressure Control Unit (R
PCU)
prevents residual pressure in the cabin and takes over the control of the outflow valve automatically. To do this, it supplies power directly to the manual motor of the outflow valve.

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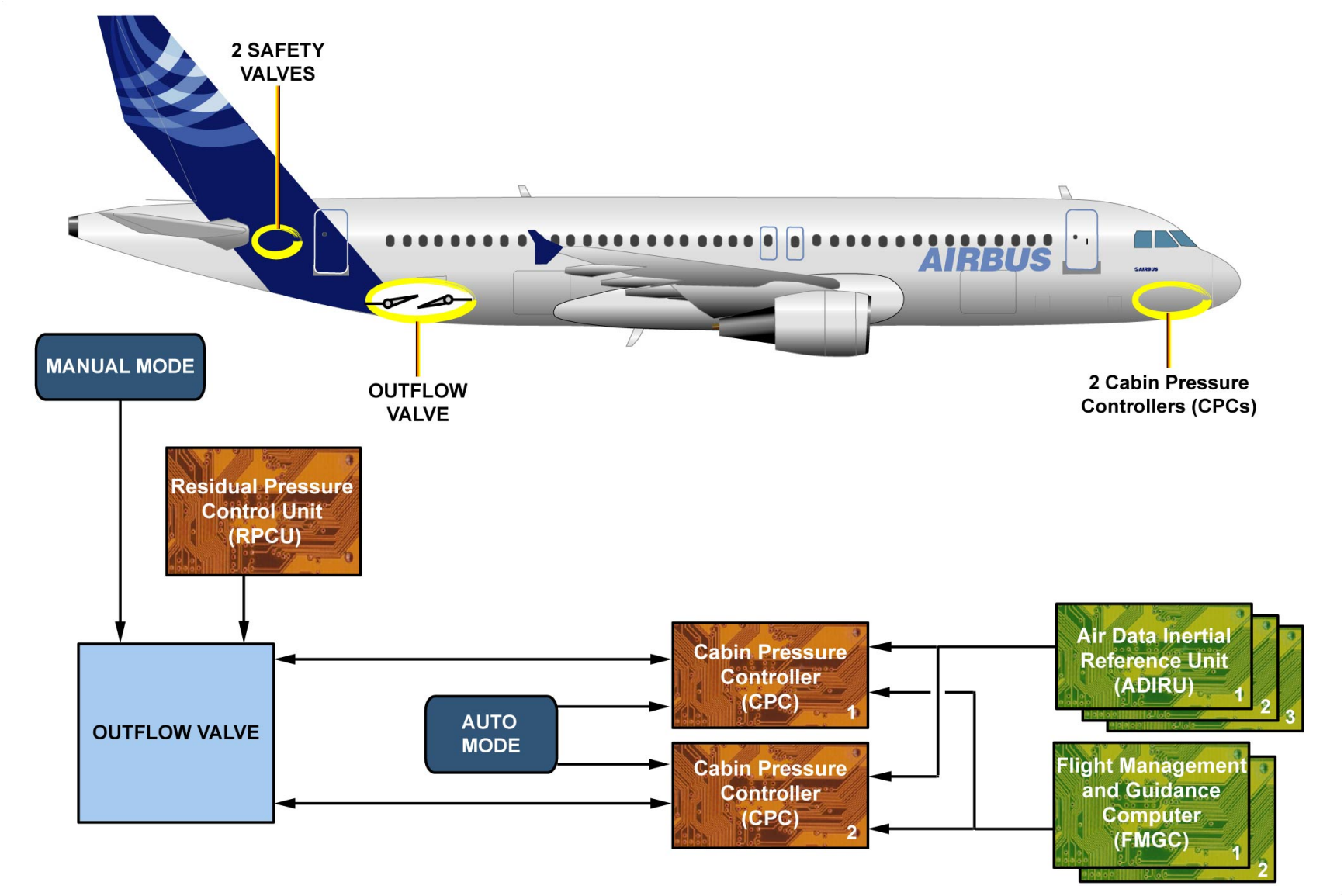

2 SAFETY VALVES
AIRBUS
MANUAL MODE
OUTFLOW VALVE
2 Cabin Pressure Controllers (CPCs)
Residual Pressure Control Unit (RPCU)
OUTFLOW VALVE
AUTO MODE
Cabin Pressure Controller (CPC) 1
Cabin Pressure Controller (CPC) 2
Air Data Inertial Reference Unit (ADIRU) 1 2 3
Flight Management and Guidance Computer (FMGC) 1 2

SYSTEM OVERVIEW - PRESSURIZATION CONTROL

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

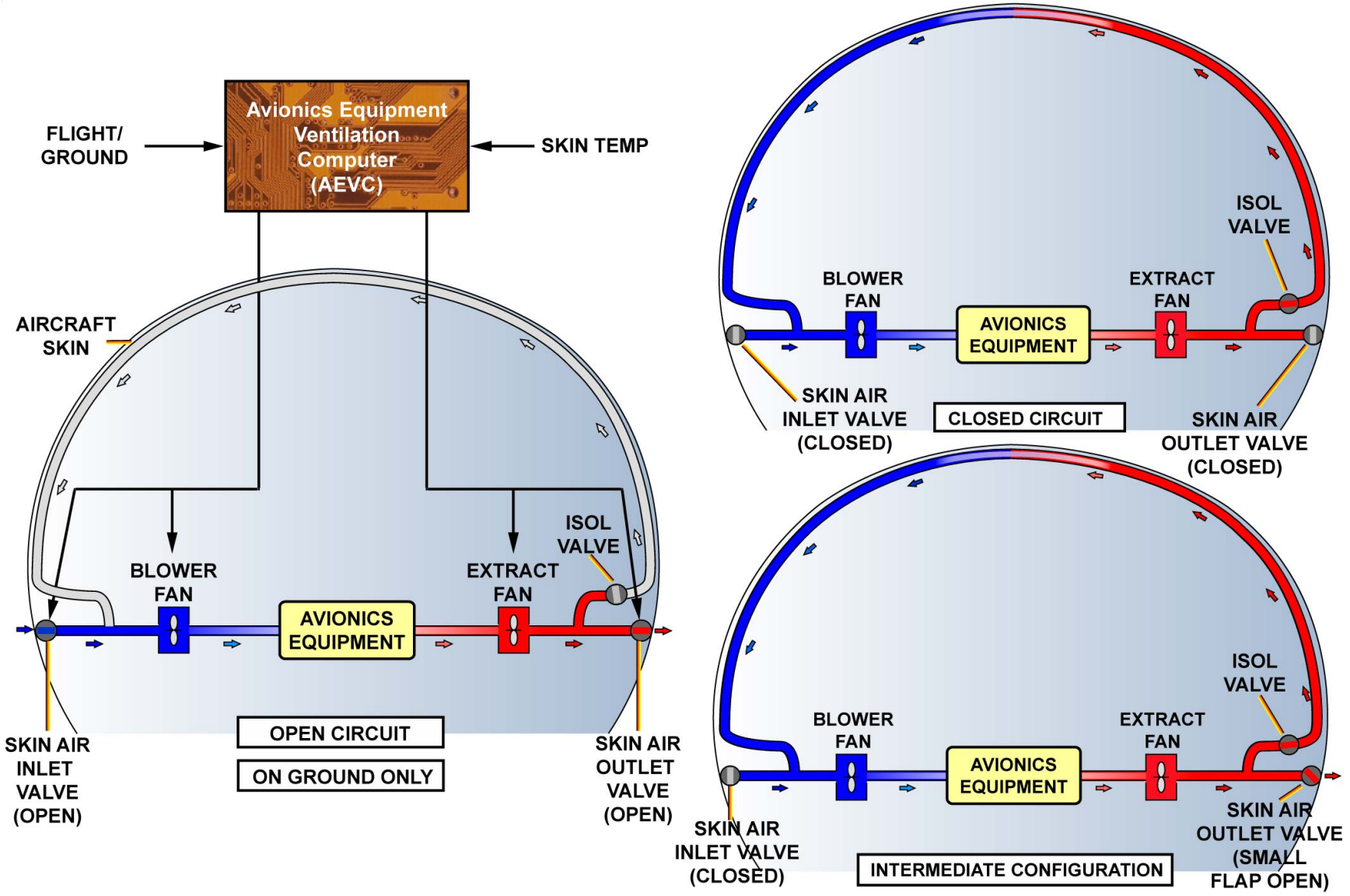
SYSTEM OVERVIEW (continued)

AVIONICS VENTILATION

The avionics ventilation system supplies cooling air to the avionics equipment. This includes the equipment in the avionics compartment, the flight deck instruments and the circuit breaker panels.
A blower fan and an extraction fan supply the air through the avionics equipment.

NOTE: Note: These fans operate continuously while the aircraft electrical system is supplied.

The Avionics Equipment Ventilation Computer (AEVC) controls the fans and the configuration of the skin valves in the avionics ventilation system based on flight / ground logic and fuselage skin temperature.
There are 3 configurations for the skin air inlet and outlet valves:
- open circuit: the two valves are open (on ground only),
- closed circuit: the two valves are closed (in flight or if there is low external air temperature on ground). The air temperature is decreased in the skin heater exchanger. The skin heat exchanger is a chamber which lets the air be in contact with the fuselage skin during flight,
- intermediate circuit: the inlet is closed and the outlet is open, but not fully.



SYSTEM OVERVIEW - AVIONICS VENTILATION

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

SYSTEM OVERVIEW (continued)

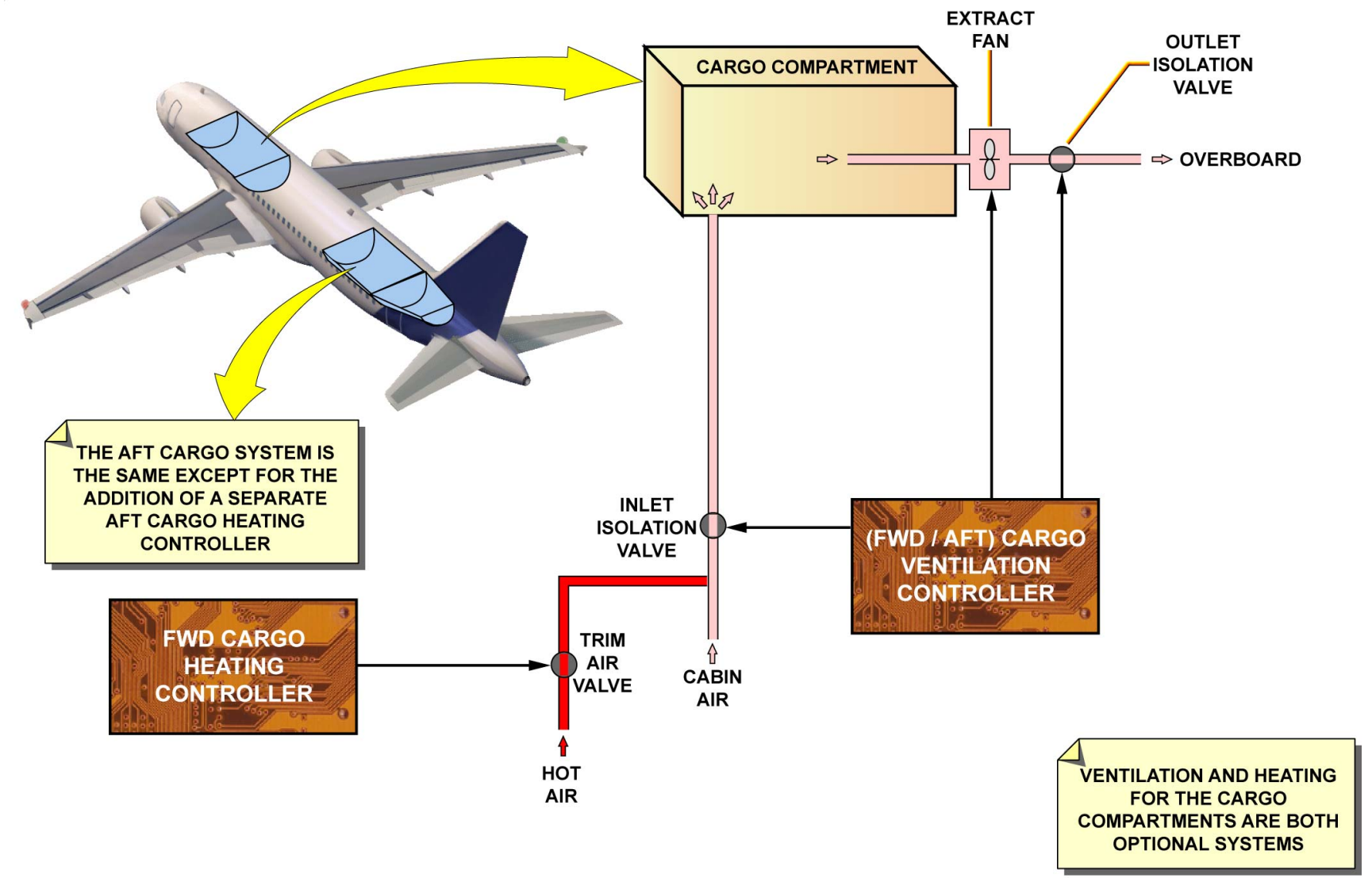
CARGO VENTILATION AND HEATING

As an option on the Airbus single aisle family, the forward and aft cargo compartments can have a ventilation system. A heating system can also be installed in these two compartments or only one of them. The heating system will only be installed together with a ventilation system.

The operation is equivalent for the two compartments, thus we will only look at the forward cargo compartment as an example. Air from the main cabin is supplied into the cargo compartment by the extract fan or by differential pressure in flight (FWD Cargo Compartment only). After its circulation through the compartment, the air is discharged overboard.

The operation of the two isolation valves and the extract fan is controlled automatically by the cargo Ventilation Controller (VC). One VC can control one cargo compartment or the two of them.

For the heating of the cargo compartment, the pilots select the desired compartment temp and hot bleed air is mixed with the air coming from the main cabin to increase the temperature if necessary. The supply of hot air is controlled by the Cargo Heating Controller. Each heated compartment has a dedicated Cargo Heating Controller. There is NO direct air conditioning supply to the cargo compartments. The pilots cannot add "cold" air to the compartments.


EXTRACT FAN
OUTLET ISOLATION VALVE
CARGO COMPARTMENT
OVERBOARD
THE AFT CARGO SYSTEM IS THE SAME EXCEPT FOR THE ADDITION OF A SEPARATE AFT CARGO HEATING CONTROLLER
INLET ISOLATION VALVE
(FWD / AFT) CARGO VENTILATION CONTROLLER
FWD CARGO HEATING CONTROLLER
TRIM AIR VALVE
CABIN AIR
HOT AIR
VENTILATION AND HEATING FOR THE CARGO COMPARTMENTS ARE BOTH OPTIONAL SYSTEMS

SYSTEM OVERVIEW - CARGO VENTILATION AND HEATING

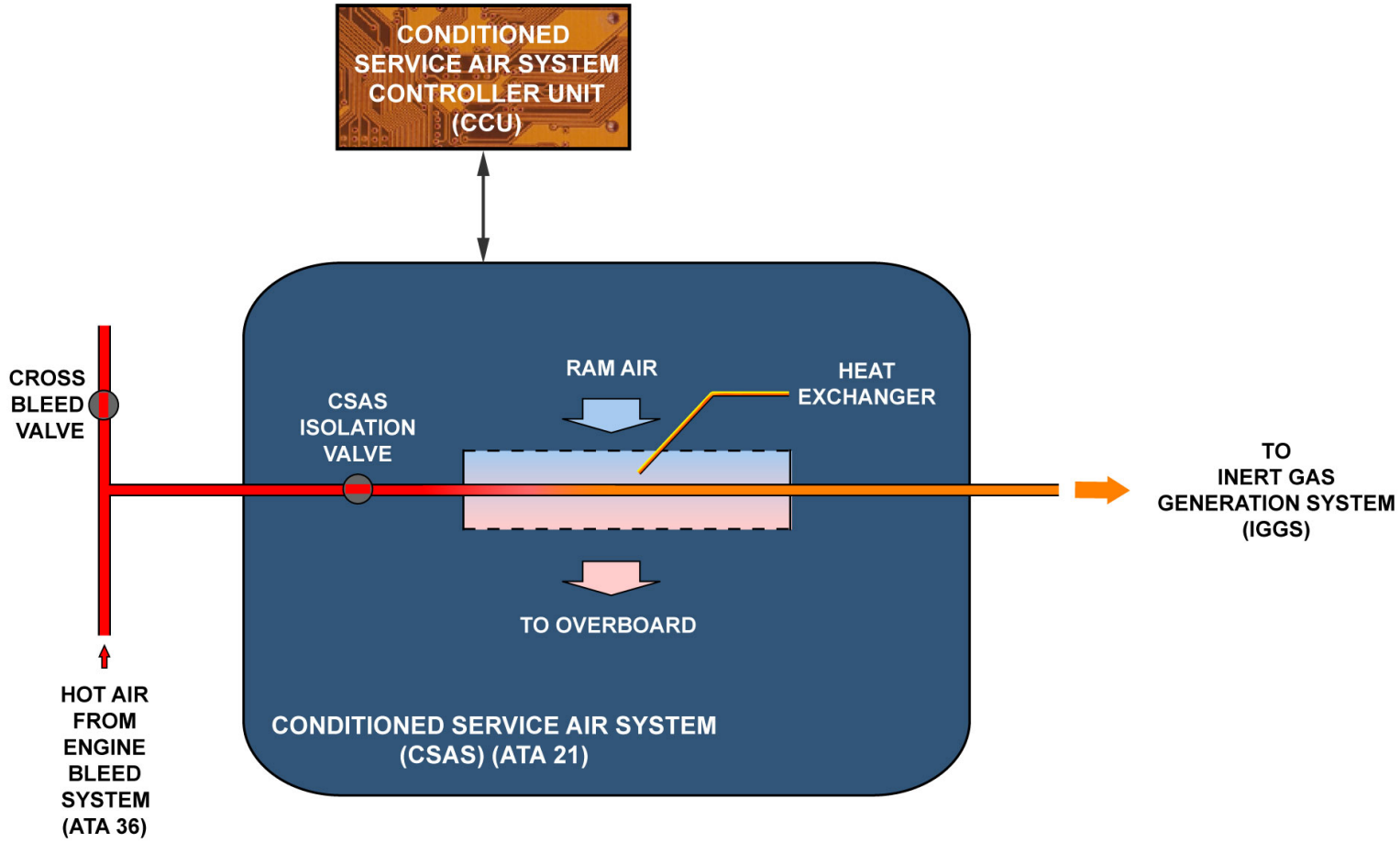
AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

SYSTEM OVERVIEW (continued)

CONDITIONED SERVICE AIR SYSTEM

The Fuel Tank Inerting System (FTIS) includes two sub-systems:
- The Conditioned Service Air System (CSAS) ATA21,
- The Inert Gas Generation System (IGGS) ATA47.

The CSAS gets hot air from the bleed air system and decreases the air temperature to a level compatible with the IGGS sub-system.
The CSAS includes:
- The Conditioned service air system Controller Unit (CCU), which does the system control and health monitoring BITE and has interfaces with the FWS and CFDS,
- A CSAS isolation valve, which is a protection of the system if there is low pressure, over pressure or over temperature,
- A heat exchanger, which decreases the air temperature.


CONDITIONED SERVICE AIR SYSTEM CONTROLLER UNIT (CCU)
CROSS BLEED VALVE
CSAS ISOLATION VALVE
RAM AIR
HEAT EXCHANGER
TO INERT GAS GENERATION SYSTEM (IGGS)
TO OVERBOARD
HOT AIR FROM ENGINE BLEED SYSTEM (ATA 36)
CONDITIONED SERVICE AIR SYSTEM (CSAS) (ATA 21)

SYSTEM OVERVIEW - CONDITIONED SERVICE AIR SYSTEM

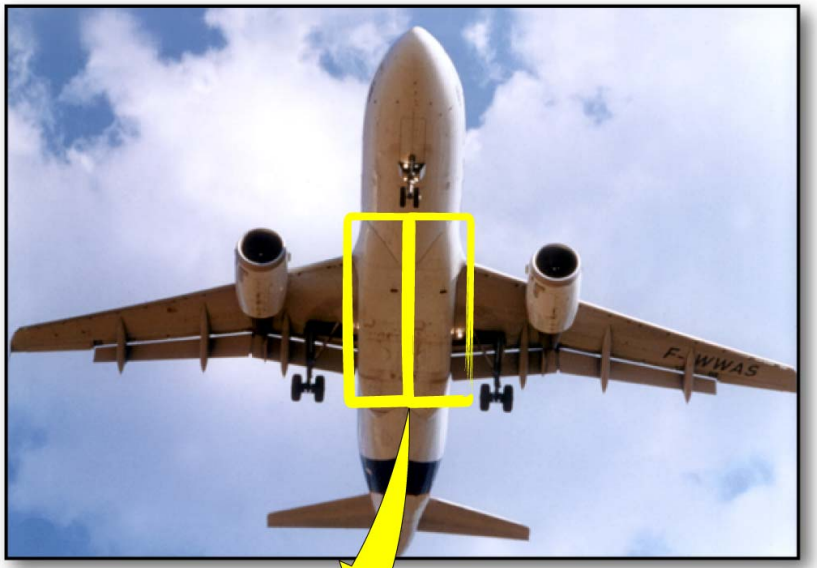
AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION

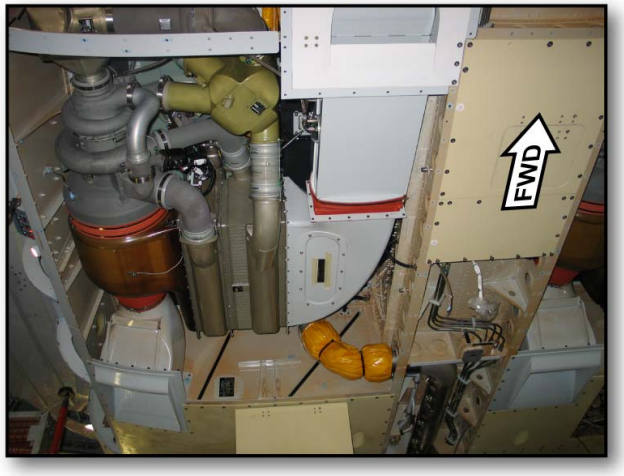
AIR CONDITIONNING SYSTEM

The left and right packs are in the air conditioning bay. The air conditioning bay is in the unpressurized belly fairing, forward of the wheel well on the lower fuselage. The belly fairing has inlets for pack and compartment cooling.

The packs supply air to the mixer unit. The mixer unit is installed at the rear of the forward cargo compartment. It mixes air from the packs and re-circulated air from the cabin before distribution to each zone.



RH PACK ASSEMBLY



MIXER UNIT & RECIRCULATION SYSTEM

COMPONENT LOCATION - AIR CONDITIONNING SYSTEM

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION (continued)

PRESSURIZATION SYSTEM

Pressurization is done by a dual gate type outflow valve.
The outflow valve is operated by three electrical motors: two for the automatic mode and one for the manual mode.
Two safety valves are installed on the pressure bulkhead at the rear of the cabin.
The RPCU is installed on the bottom right-hand side of the avionics compartment 90VU.

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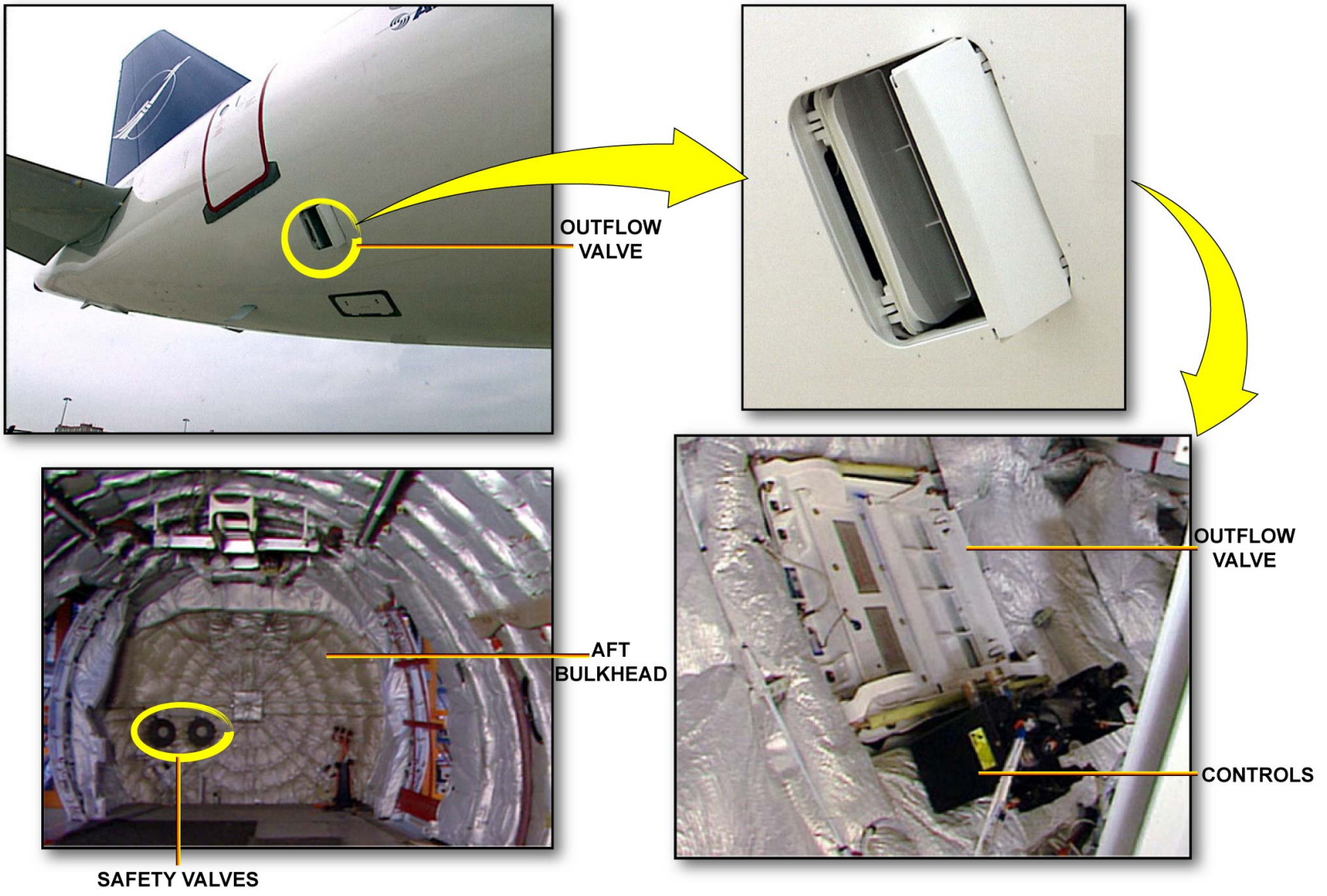
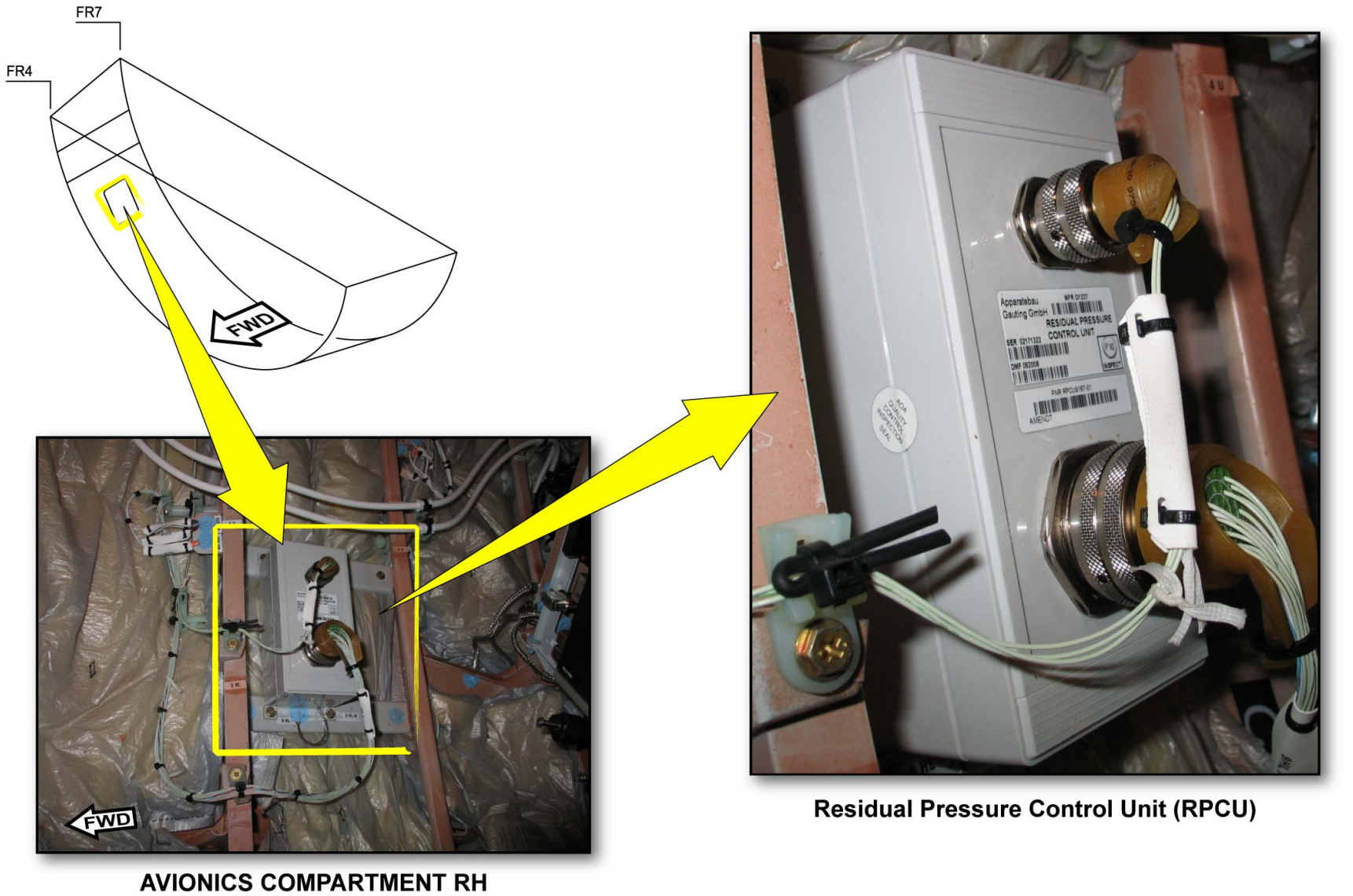


COMPONENT LOCATION - PRESSURIZATION SYSTEM



COMPONENT LOCATION - PRESSURIZATION SYSTEM

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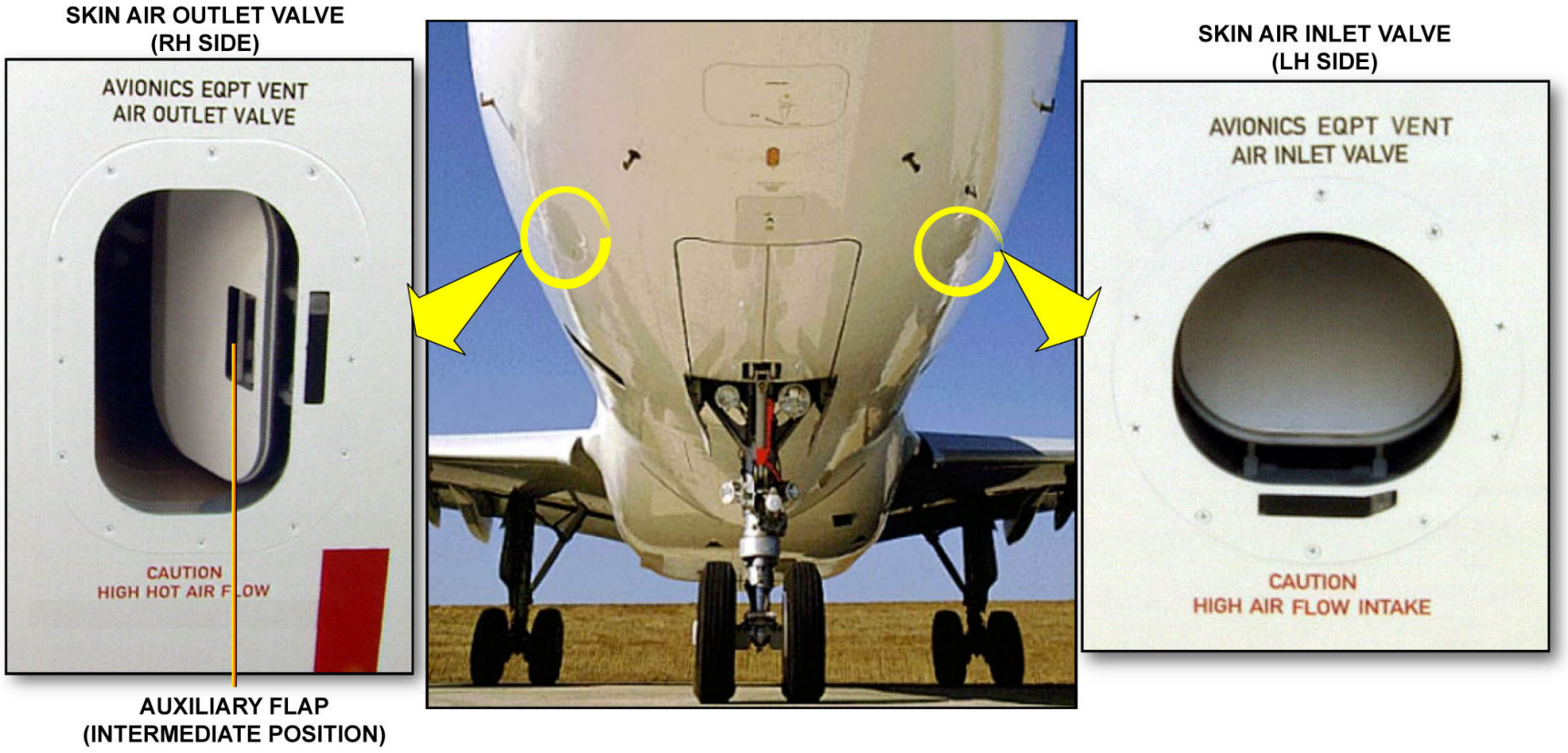
AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION (continued)

VENTILATION SYSTEM

The skin air inlet valve is on the LH side of the fuselage.
The skin air outlet valve is on the RH side of the fuselage. A small auxiliary flap will open for the intermediate circuit configuration. This is the not-fully-open position. It will also open for smoke removal in flight.
The two skin valves have a manual override and deactivation device.



COMPONENT LOCATION - VENTILATION SYSTEM

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION (continued)

FWD CARGO VENTILATION AND HEATING SYSTEM

The isolation valves and extract fan of the forward cargo compartment ventilation system are behind the compartment sidewall panels. Grills give protection to the air inlets and outlets.

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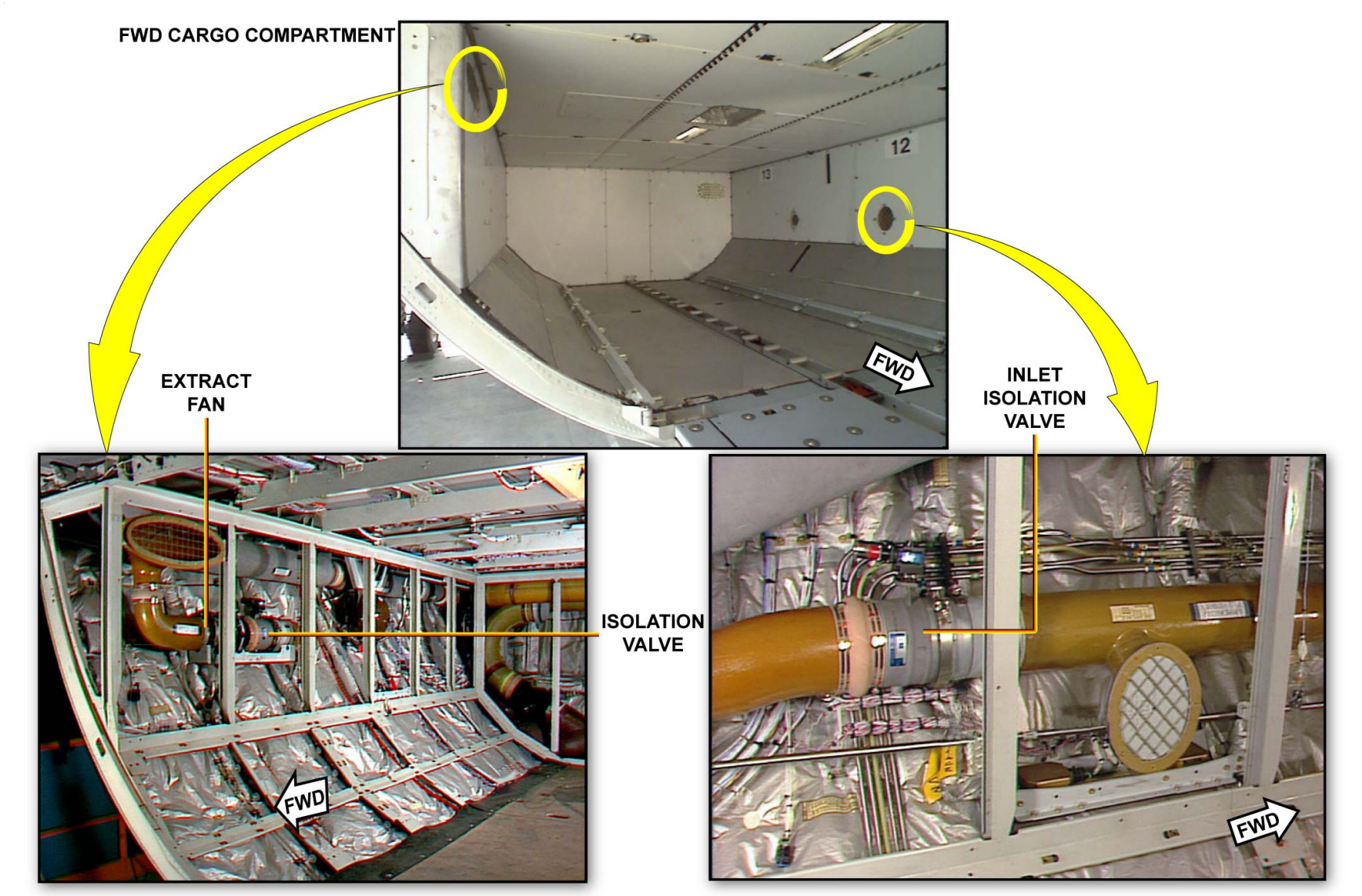


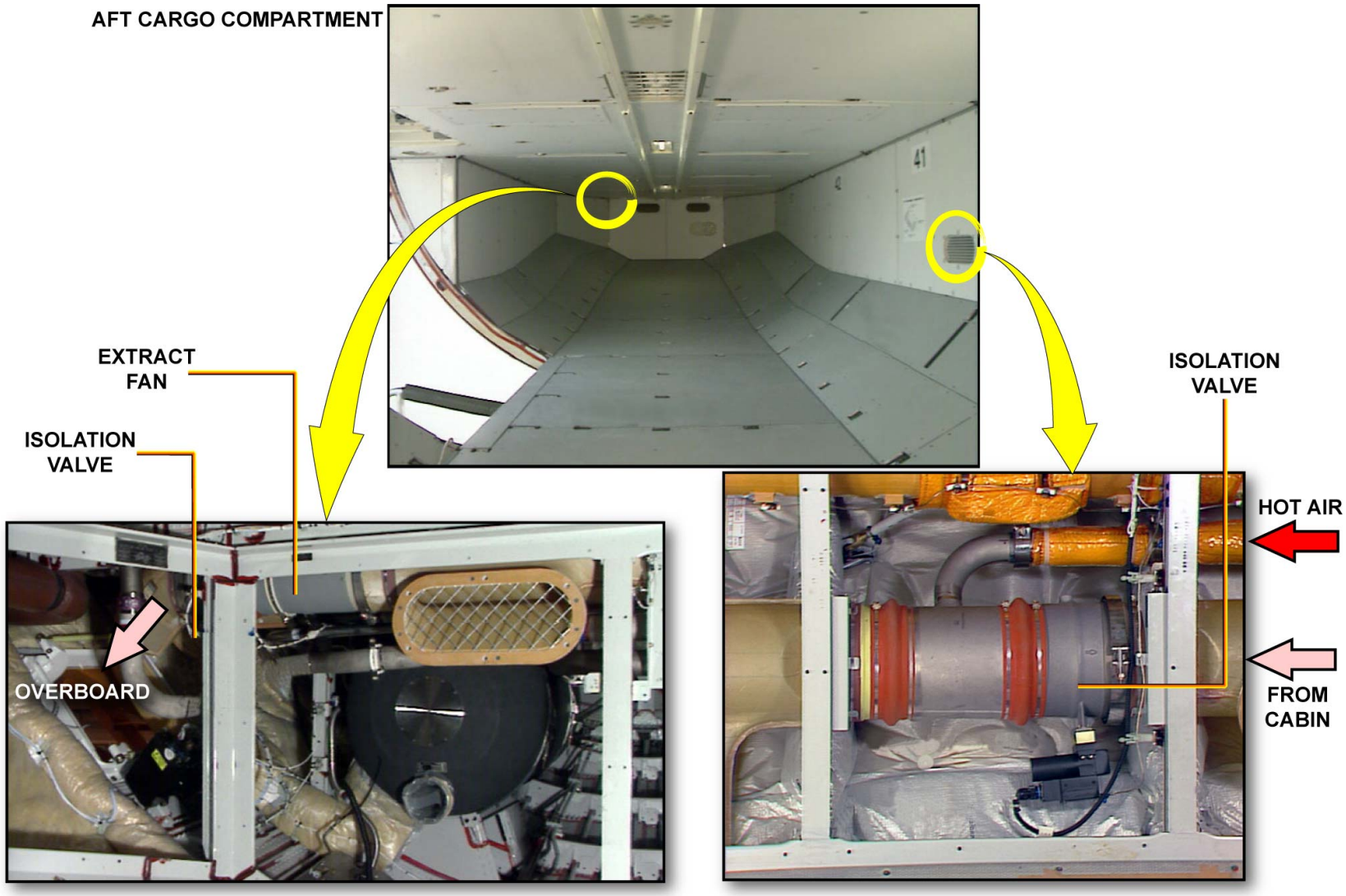
COMPONENT LOCATION - FWD CARGO VENTILATION AND HEATING SYSTEM

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION (continued)

AFT CARGO VENTILATION AND HEATING SYSTEM

In the aft cargo compartment, an isolation valve and extract fan are installed behind the compartment rear wall and the inlet isolation valve behind the left sidewall lining.



COMPONENT LOCATION - AFT CARGO VENTILATION AND HEATING SYSTEM

AIR CONDITIONING SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION (continued)

CONDITIONED SERVICE AIR SYSTEM

The Conditioned Service Air System is installed on the left hand side of the aircraft belly fairing next to pack no.1.

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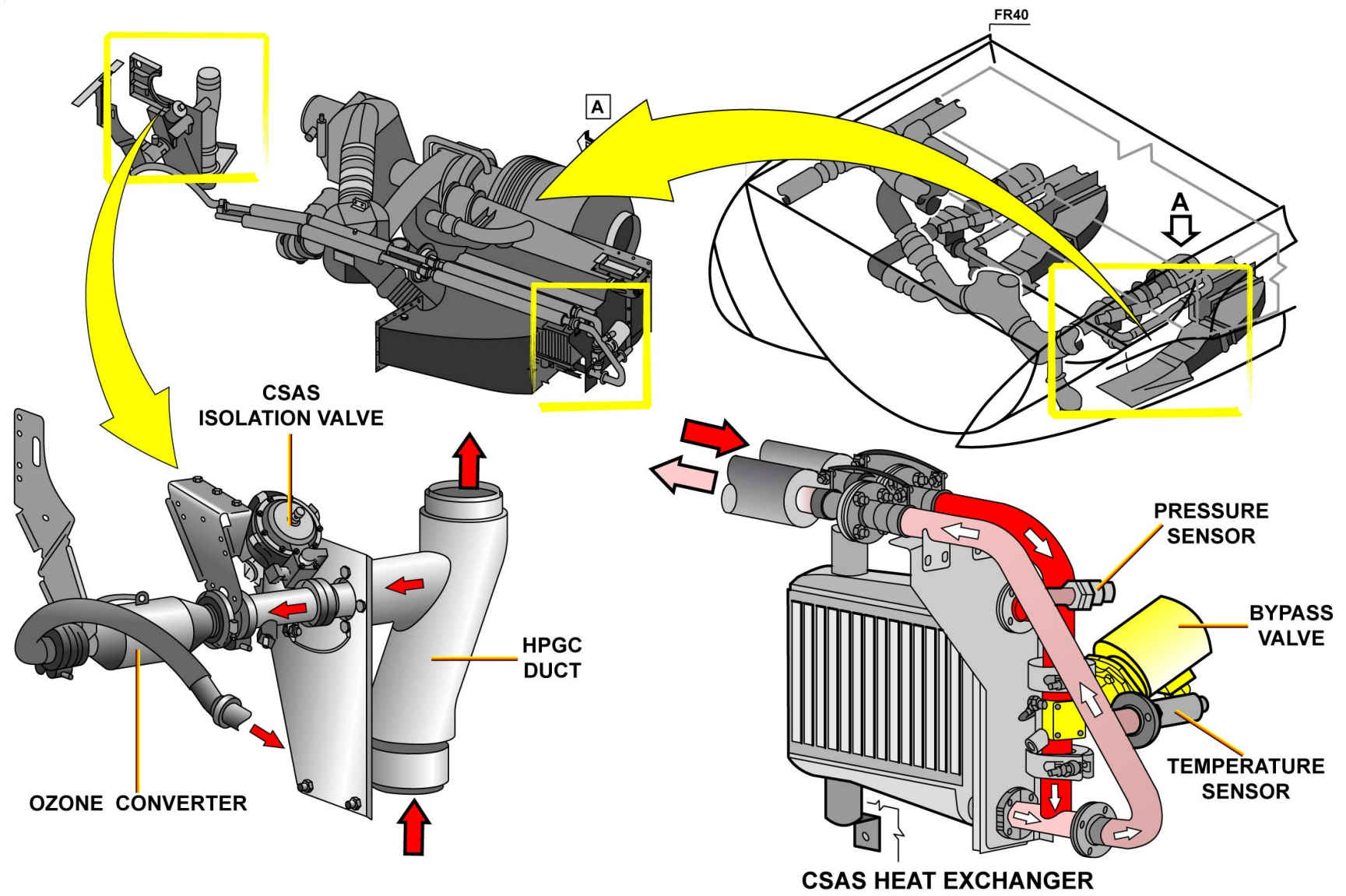

COMPONENT LOCATION - CONDITIONED SERVICE AIR SYSTEM

AIR CONDITIONING SYSTEM CONTROL & INDICATING (2)

LOCATE CONTROL/INDICATING IN COCKPIT

AIR CONDITIONING SUB-SYSTEMS

CABIN PRESSURIZATION SYSTEM

VENTILATION SUB-SYSTEMS

EMERGENCY CONTROL - DITCHING

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SYSTEM PRESENTATION (2)

BASIC PRINCIPLE

The flow of hot air from the air bleed system is regulated before it enters the packs in order to be temperature regulated. Hot air pressure is maintained above the cabin pressure, which lets the hot airflow join the pack air supply when necessary. Part of the cabin air is recirculated to decrease air supply demand.

PACK UNITS

The airflow from the air bleed system is regulated by two pack Flow Control Valves (FCVs). Two independent packs then supply air with a regulated temperature to the mixer unit. Both packs supply air at the same temperature.

MIXER UNIT

The mixer unit mixes air with a regulated temperature from the packs with part of the cabin air supplied by the recirculation fans. The mixer unit can also receive conditioned air from an LP ground connection or fresh outside air from the emergency ram air inlet. The emergency ram air inlet supplies outside fresh air for ventilation of the A/C in emergency conditions when there is loss of both packs or smoke removal.

TRIM AIR PRV

Hot air tapped upstream of the packs supplies the trim air valves through a trim air Pressure Regulating Valve (PRV). This valve regulates the downstream pressure 4 psi above the cabin pressure.

HOT TRIM AIR

A trim air valve associated with each zone optimizes the temperature by adding hot air, if necessary, to the air from the mixer unit.

AIR DISTRIBUTION

The conditioned air is distributed to three main zones:
- cockpit,
- forward cabin,
- aft cabin.

Normally, the mixer unit lets the cockpit be supplied from pack 1 and FWD and aft cabins from pack 2.

LAV AND GALY VENTILATION

The LAVatory and GALleY ventilation system uses air from the cabin zones. A fan extracts this air through the outflow valve.

NOTE: Note: The LAV and GALY ventilation system is also used to ventilate the cabin zone temperature sensors.

ACSC

The Air Conditioning System Controller (ACSC) does:
- temperature regulation in accordance with demand,
- flow control and monitoring in accordance with flow control demand.

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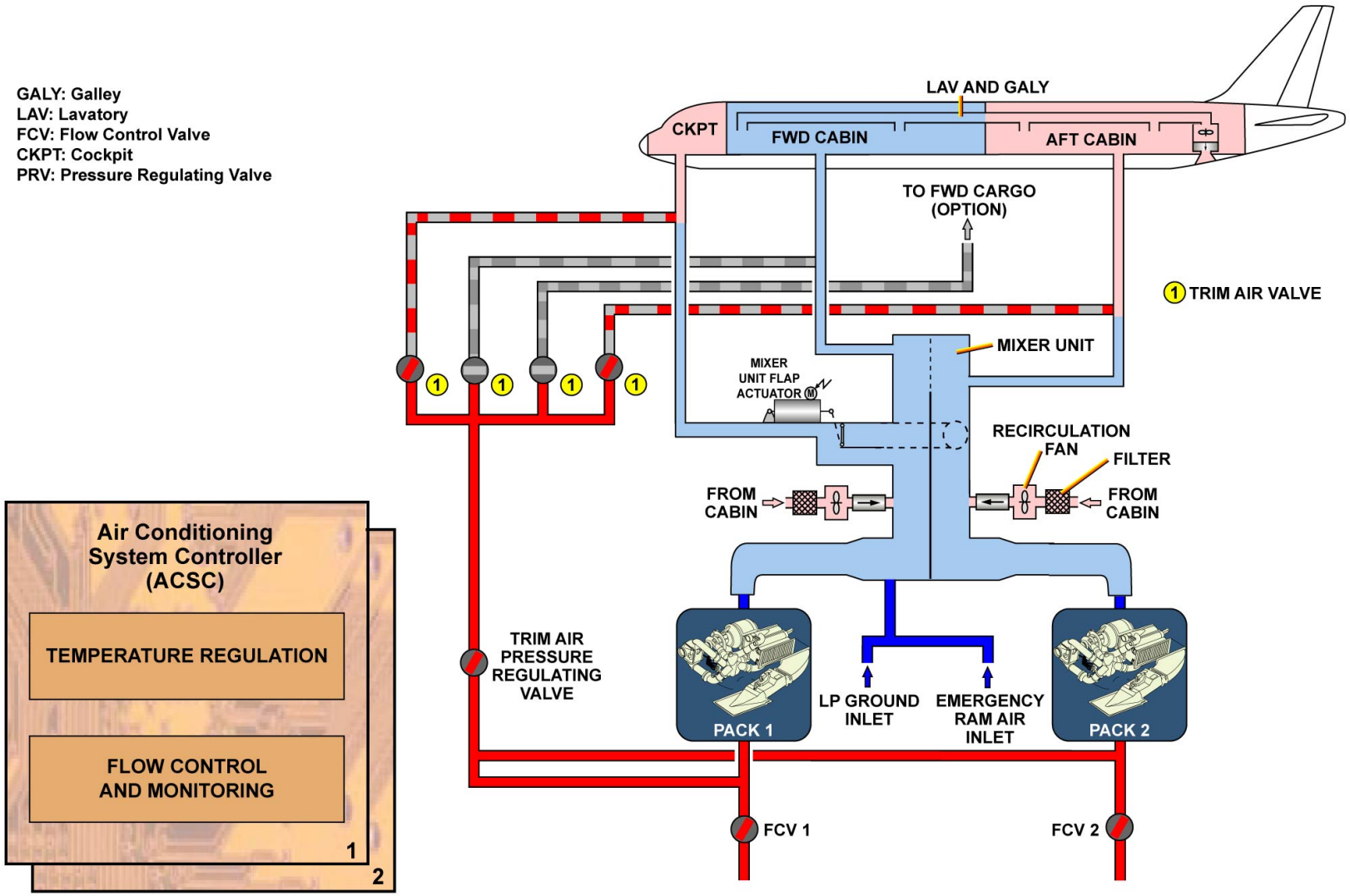

BASIC PRINCIPLE ... ACSC

PACK PRESENTATION (2)

PACK FCV

Each pack Flow Control Valve (FCV) is pneumatically actuated and electrically controlled. The flow regulation is done by a torque motor under the control of the Air Conditioning System Controller (ACSC). If the pack compressor outlet temperature is > 215°C (419°F), the FCV starts to reduce the flow. A compressor outlet temperature > 260°C (500°F) results in a pack overheat warning.

NOTE: Note: Part of the hot air, downstream of the pack FCV, is sent to the trim air Pressure Regulating Valve (PRV).
Each pack FCV is automatically closed during either a same side engine start sequence or an opposite side engine start sequence, if the crossbleed valve is detected open. It reopens 30 seconds after the end of any engine start sequence.

EXCHANGERS - COMPRESSOR

Bleed air is ducted to the primary heat exchanger, then to the compressor. The air is cooled in the main heat exchanger. It then goes through the reheater, the condenser and the water extractor in order to remove water particles from the air entering the turbine.

TURBINE

The air expands in the turbine section, which results in a very low turbine discharge air temperature. The turbine drives the compressor and the cooling air fan.

RAM AIR INLET FLAP AND BYP VALVE

The BYPass valve and the ram air inlet flap are simultaneously controlled by the air conditioning system controller. The BYP valve is operated by an electro-mechanical actuator to modulate the pack discharge temperature by adding hot air. The ram air inlet flap modulates the airflow through the exchangers. To increase cooling, the ram air inlet flap opens more and the BYP valve closes more. To increase heating, the ram air inlet flap closes more and the BYP valve opens more. During take-off and landing, the ram air inlet flap is closed to prevent ingestion of foreign objects.

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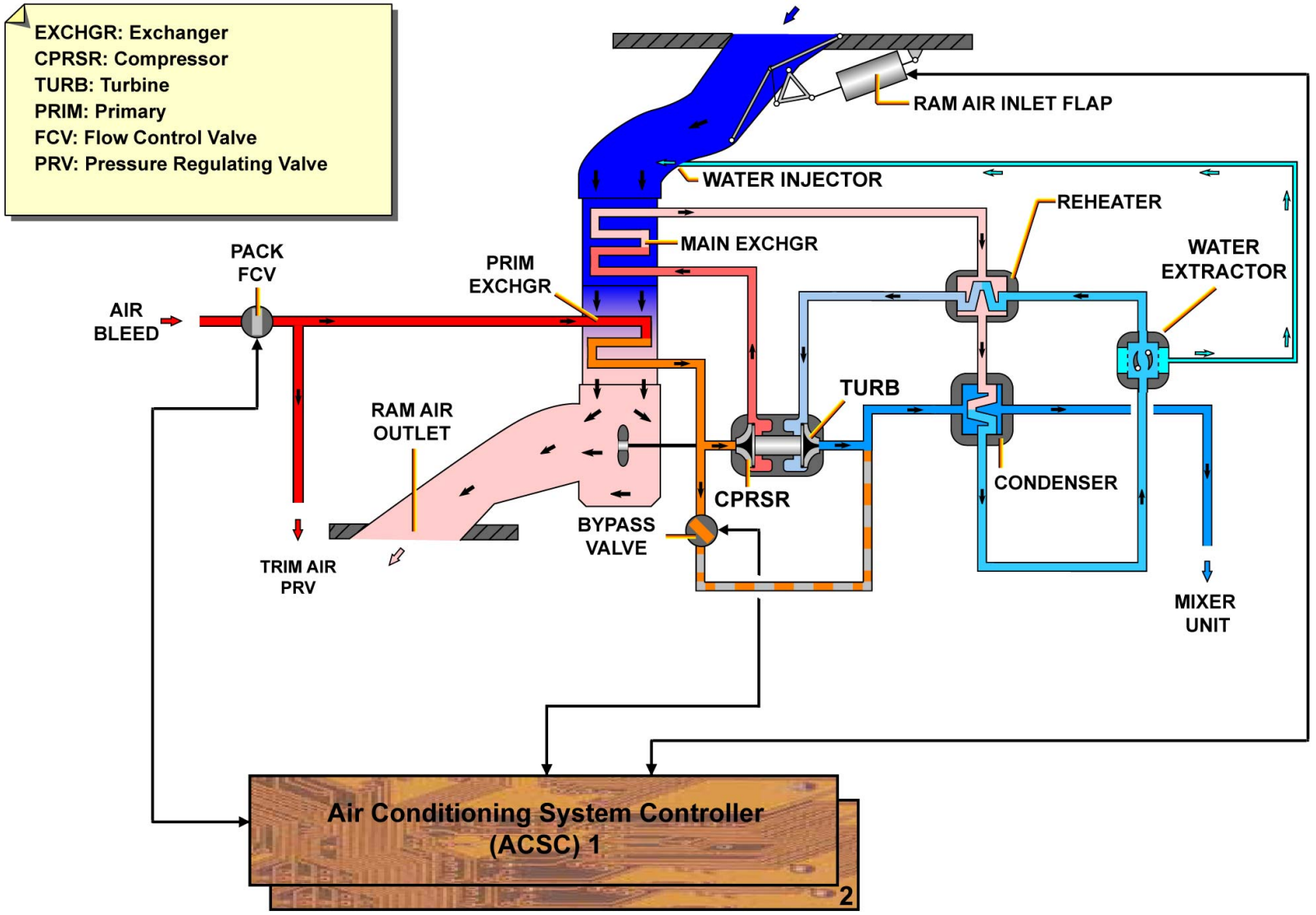

PACK FCV ... RAM AIR INLET FLAP AND BYP VALVE

FLOW CONTROL & PACK COMPONENTS D/O (3)

OZONE CONVERTER

High-pressure, high-temperature air from the bleed system is supplied to the pack Flow Control Unit (FCU) through the OZONE CONVERTER, which is used for catalytic removal of ozone from the hot bleed air supplied to the pack.

FLOW CONTROL UNIT GENERAL

The FCU includes the Flow Control Valve (FCV). The FCV is an electro-pneumatic butterfly valve that does the primary functions given below:
- control of the mass flow of bleed air that goes into the pack,
- isolation of the pack from the bleed air supply (crew selection, engine fire, ditching, or engine start),
- Air Cycle Machine (ACM) overheat and low pressure start-up protection controlled by the Air Conditioning System Controllers (ACSCs). ACSC 1 controls the FCU for pack 1 and ACSC 2 controls the FCU for pack 2.

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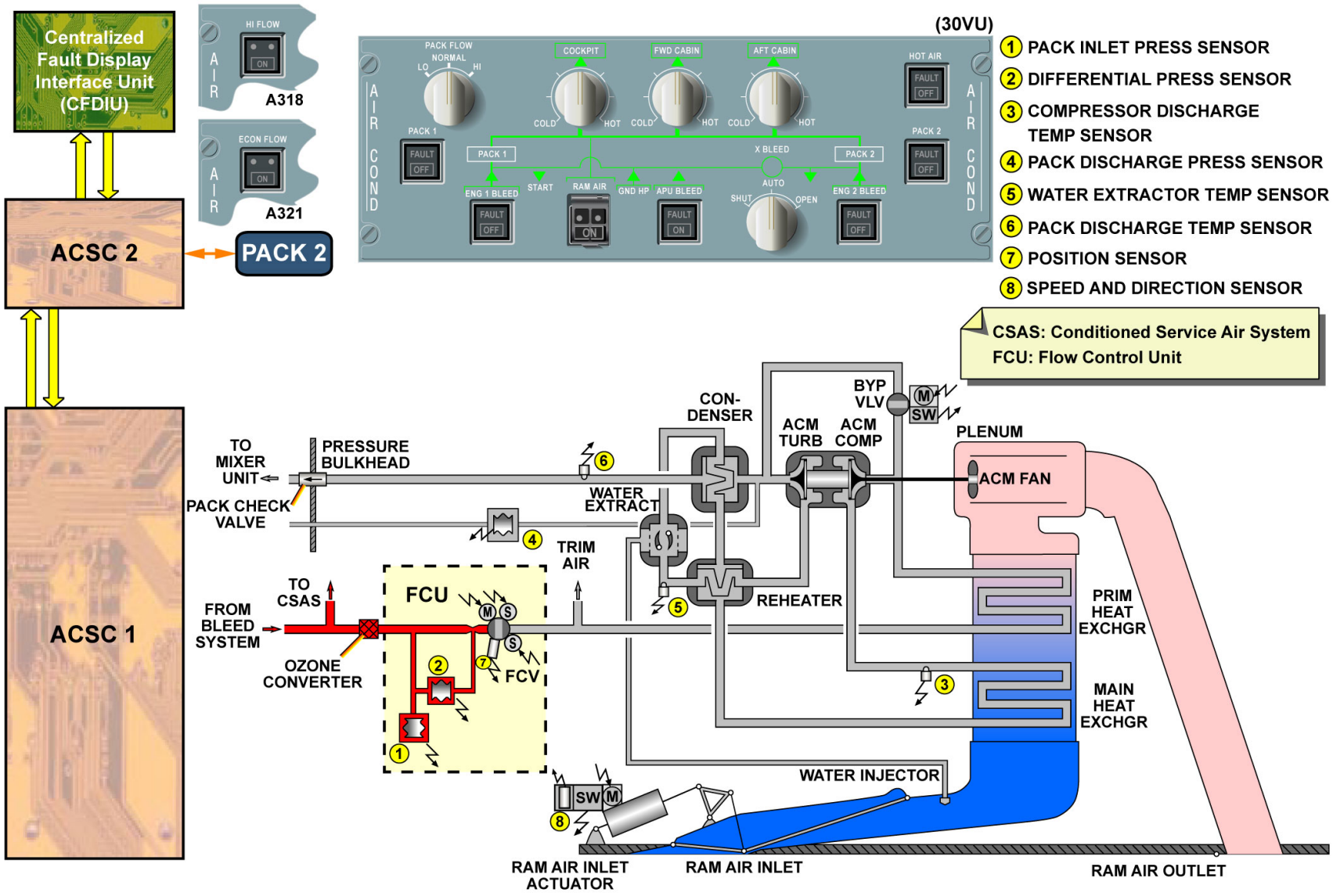

OZONE CONVERTER & FLOW CONTROL UNIT GENERAL

FLOW CONTROL & PACK COMPONENTS D/O (3)

FLOW CONTROL UNIT

Each FCU includes the FCV, 2 solenoids, one torque motor, one position sensor and 2 pressure sensors.
The FCU operates in MAIN or BACK-UP mode, controlled by the ACSC through the solenoids.
The functions of the components are:
- Solenoid 1 controls the ON/OFF (isolation) function. When this solenoid is energized, the FCV is open and regulates when bleed air pressure is available.
- Solenoid 2 controls the MAIN or BACK-UP operation. When this solenoid is de-energized, the FCV operates in MAIN mode. The solenoid is energized for BACK-UP operation.

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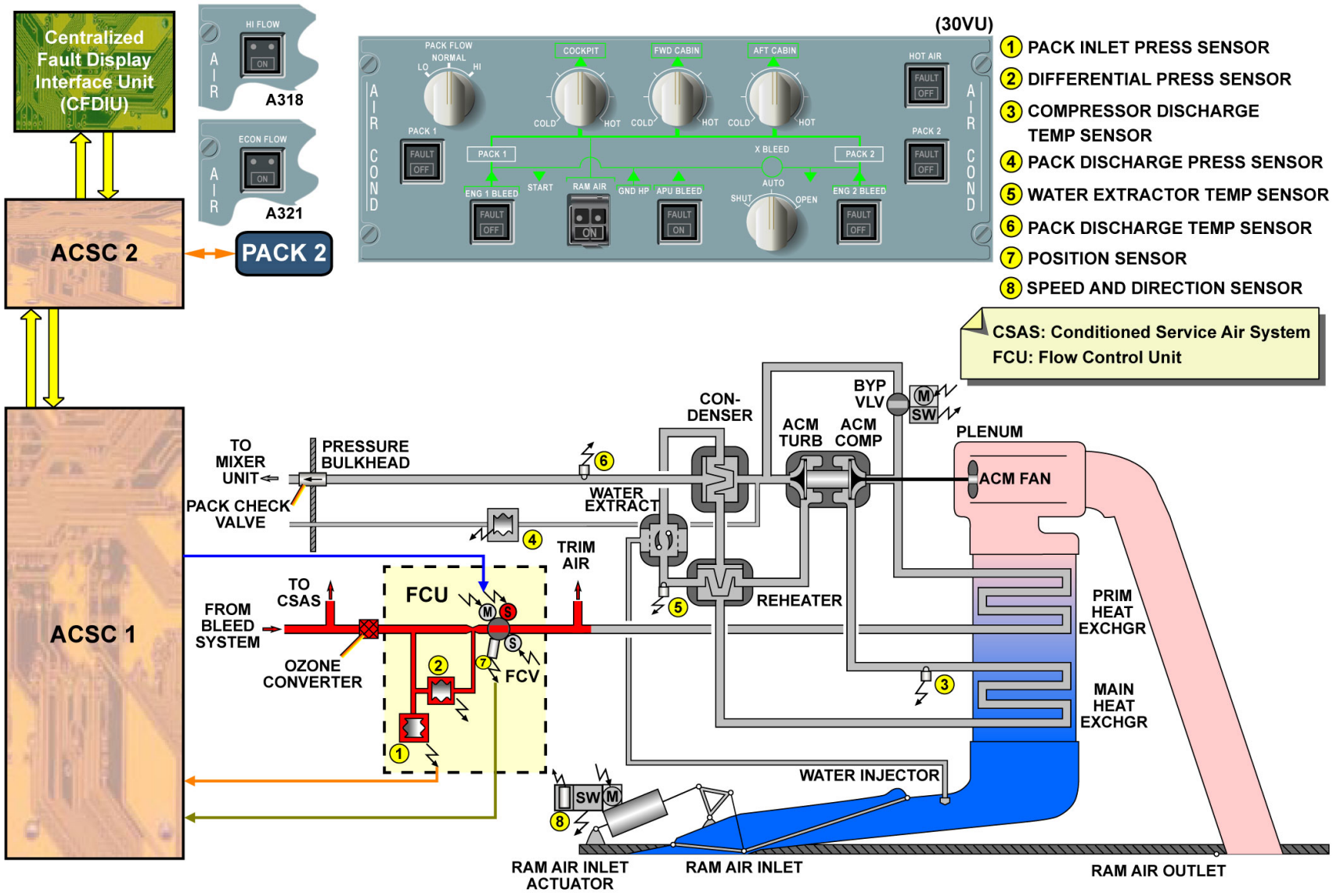

FLOW CONTROL UNIT

FLOW CONTROL & PACK COMPONENTS D/O (3)

MAIN OPERATING MODE

In the main operating mode, the FCV position is modulated for each of the conditions given below:
- changing flow demands,
- control priorities (take-off, landing, pack start, etc.),
- failures and pack overheat conditions.

The flow regulation is a function of the torque motor controlled by the related ACSC compared with the flow setting on panel 30VU.
The ACSC uses the signal from the DIFFERENTIAL PRESS SENSOR to determine the air flow that goes through the pack.
ACSC 1 only does the air flow calculation. The signal is then sent to ACSC 2 for the flow control of pack 2.
In some special aircraft configurations, the air flow is set to a specified value.
These default settings are:
HIGH FLOW:
- during pack operation with the APU bleed air supply,
- during single pack operation.

LOW FLOW:
- during take-off and landing.

The PACK INLET PRESSURE SENSOR is used to calculate the bleed air necessary for the pack operation.

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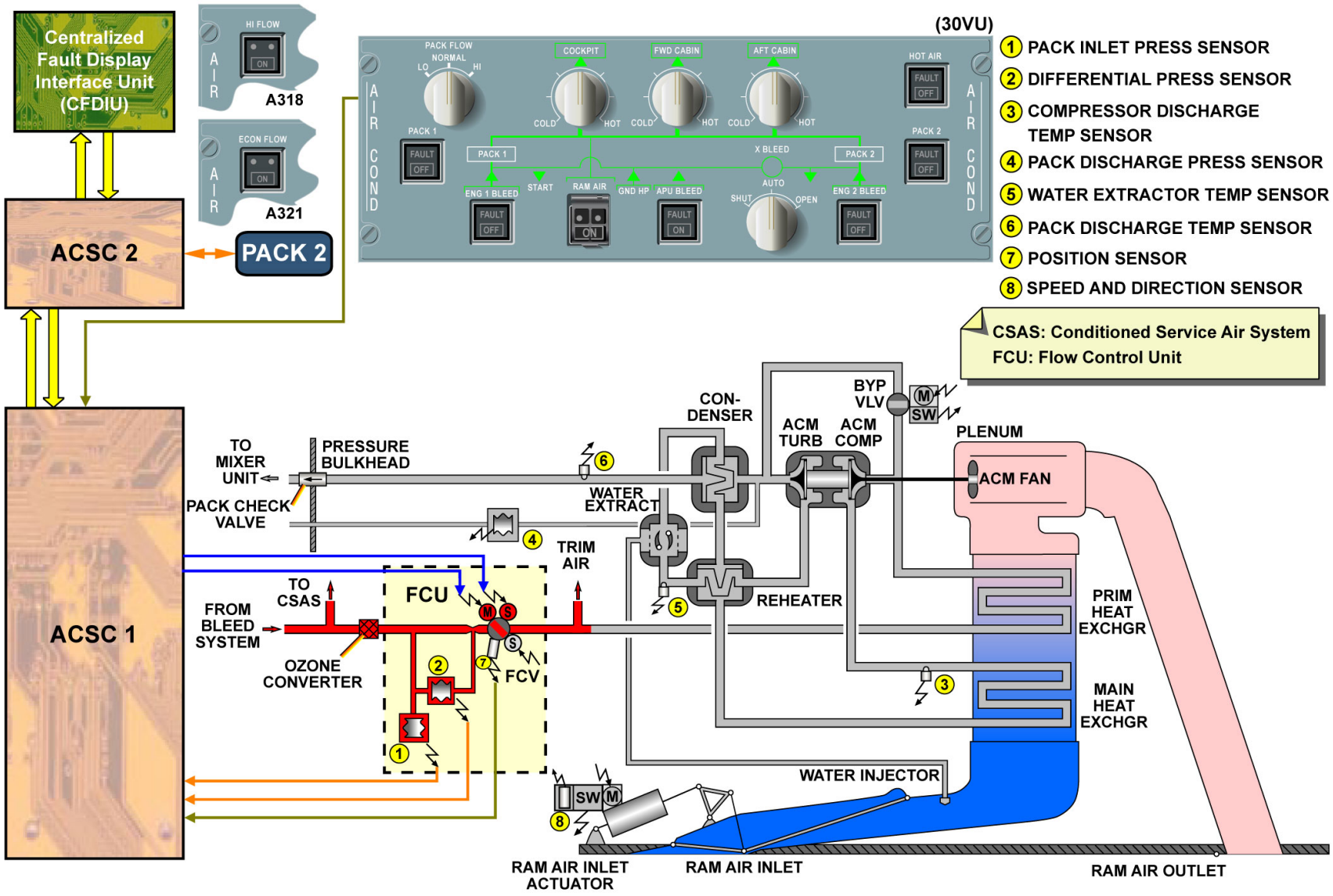

MAIN OPERATING MODE

FLOW CONTROL & PACK COMPONENTS D/O (3)

BACK-UP OPERATING MODE

If there is a malfunction of an FCU component (e.g. Flow sensor, Torque Motor or Pressure Sensor), the ACSC energizes the second solenoid and the pack operates in back-up mode.
In back-up mode, a downstream pressure regulator controls the FCV flow.

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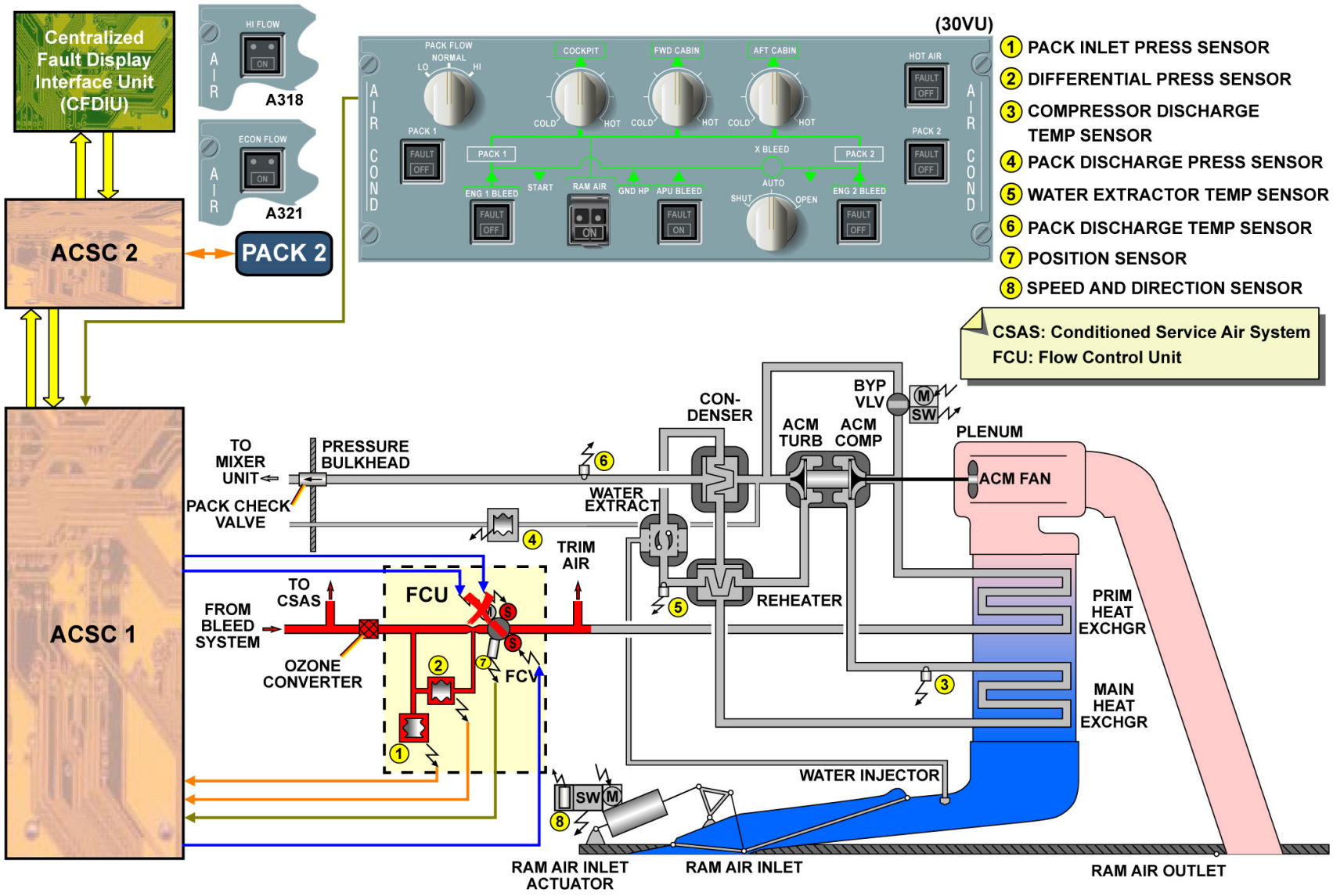

BACK-UP OPERATING MODE

FLOW CONTROL & PACK COMPONENTS D/O (3)

PRIMARY HEAT EXCHANGER AND COMPRESSOR

To prevent too high a temperature, the PRIMary HEAT EXCHanGeR is used to decrease the temperature of the hot bleed air before it goes into the ACM compressor. The primary heat exchanger is an air-to-air heat exchanger type and the cooling medium used is external ram air.
The compressor increases the air pressure and thus increases the energy of the air. At the same time, the air temperature increases again.

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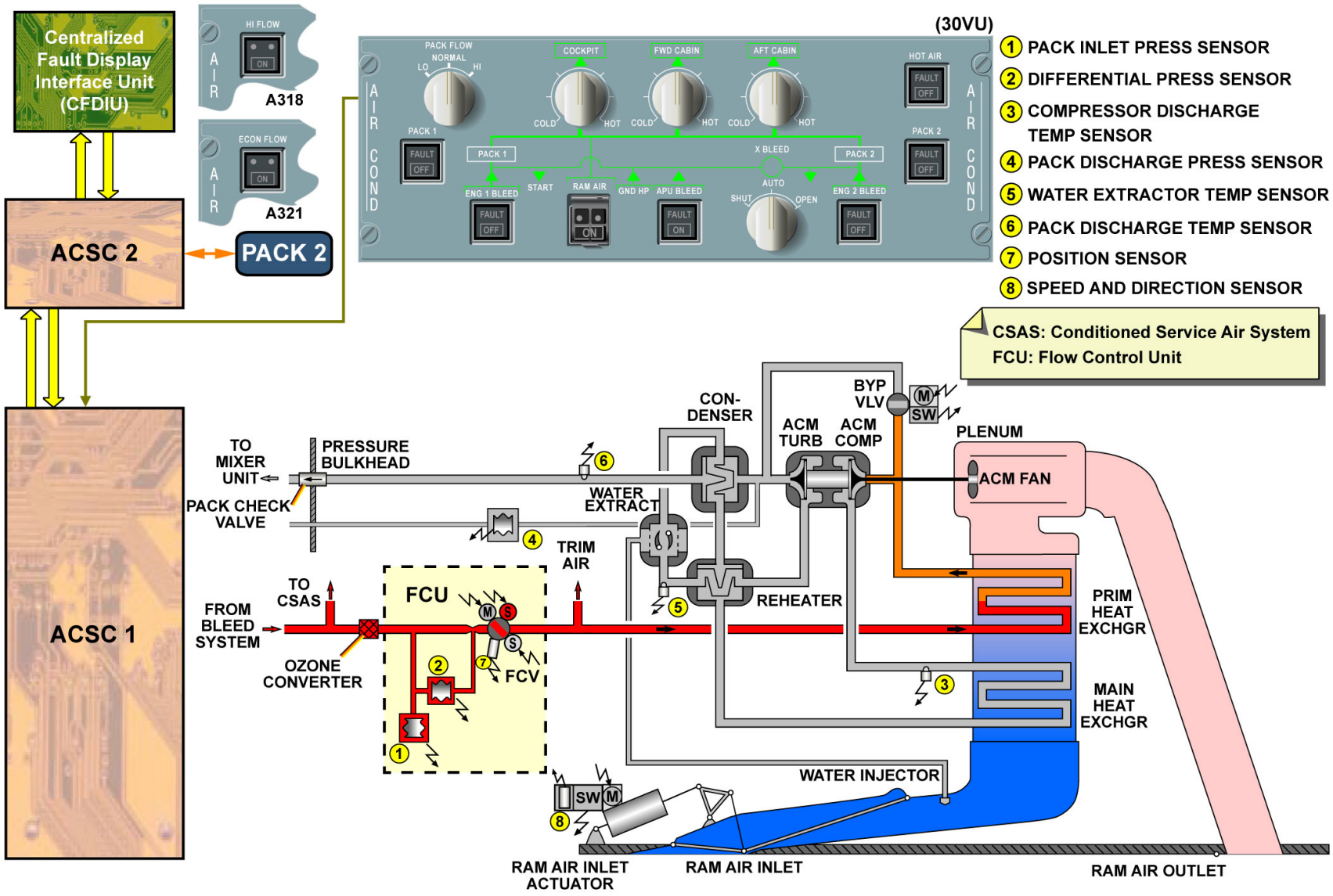
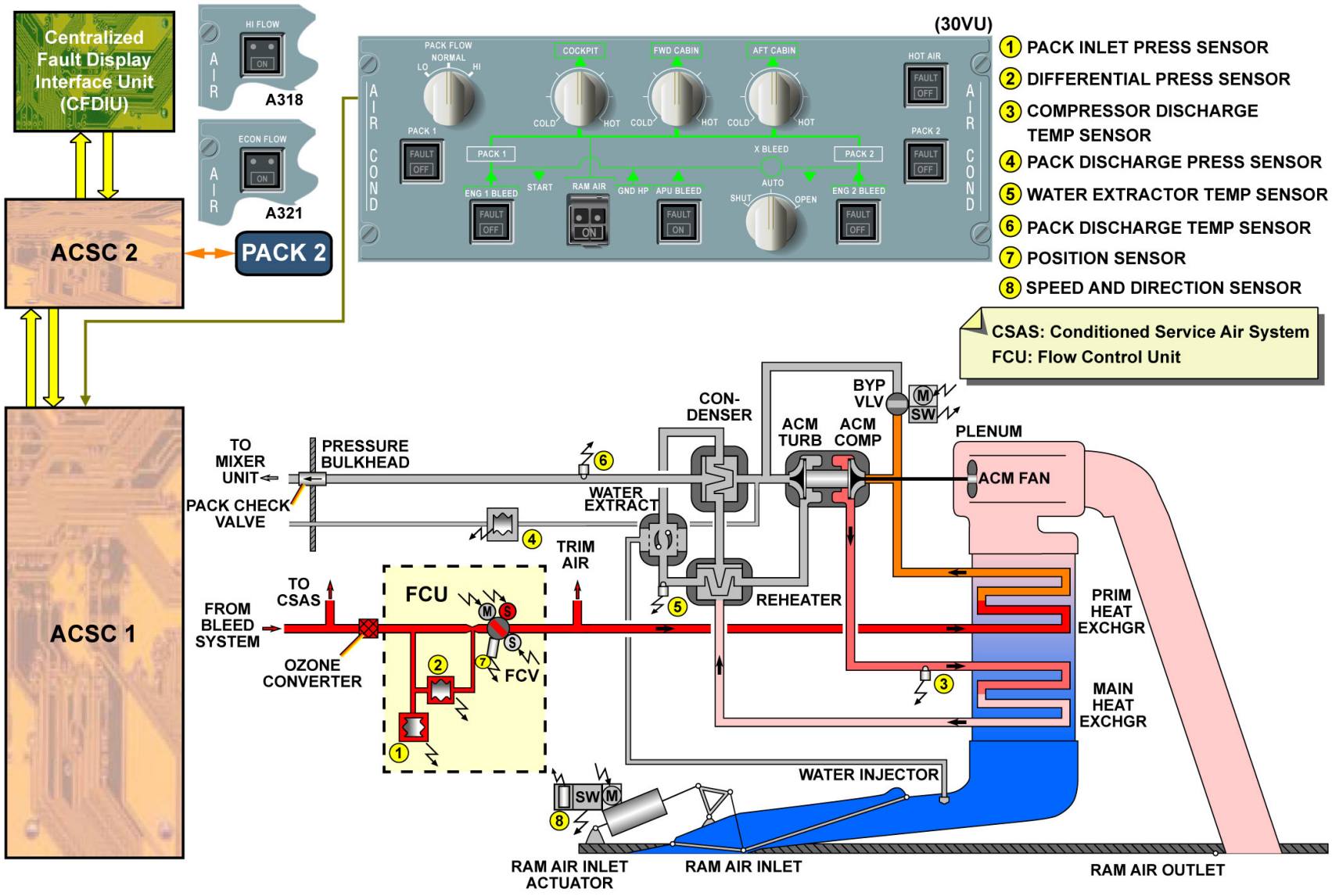


PRIMARY HEAT EXCHANGER AND COMPRESSOR

FLOW CONTROL & PACK COMPONENTS D/O (3)

MAIN HEAT EXCHANGER

The MAIN HEAT EXCHGR decreases the temperature of the high pressurized air that comes from the ACM compressor.



MAIN HEAT EXCHANGER

FLOW CONTROL & PACK COMPONENTS D/O (3)

CONDENSER

The condenser is an air-to-air heat exchanger type and is used to decrease the air temperature below the dew point.
The humidity contained in the air will condensate and make water droplets. This is necessary to extract the humidity from the air.

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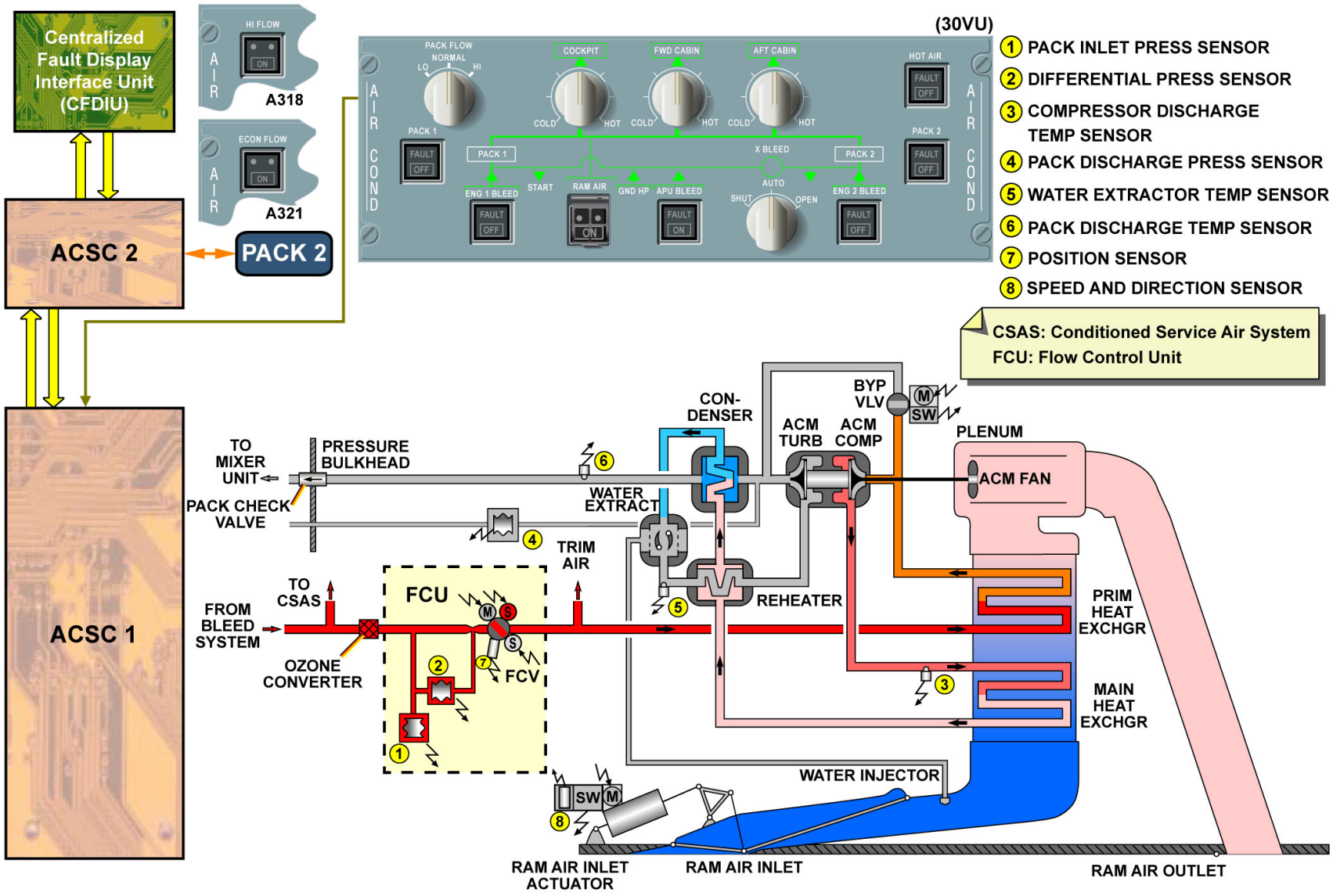
Centralized Fault Display Interface Unit (CFDIU)
HI FLOW
A318
ECON FLOW
A321
ACSC 2
PACK 2
ACSC 1
(30VU)
PACK FLOW
NORMAL
LO
HI
COCKPIT
FWD CABIN
AFT CABIN
HOT AIR
PACK 1
PACK 2
X BLEED
ENG 1 BLEED
START
RAM AIR
GND HP
APU BLEED
AUTO
SHUT
OPEN
ENG 2 BLEED
COLD
HOT
FAULT
OFF
ON
AIR COND
1 PACK INLET PRESS SENSOR
2 DIFFERENTIAL PRESS SENSOR
3 COMPRESSOR DISCHARGE TEMP SENSOR
4 PACK DISCHARGE PRESS SENSOR
5 WATER EXTRACTOR TEMP SENSOR
6 PACK DISCHARGE TEMP SENSOR
7 POSITION SENSOR
8 SPEED AND DIRECTION SENSOR
CSAS: Conditioned Service Air System
FCU: Flow Control Unit
CON-DENSER
BYP VLV
ACM TURB
ACM COMP
PLENUM
ACM FAN
TO MIXER UNIT
PRESSURE BULKHEAD
PACK CHECK VALVE
WATER EXTRACT
TRIM AIR
TO CSAS
FROM BLEED SYSTEM
FCU
FCV
OZONE CONVERTER
REHEATER
PRIM HEAT EXCHGR
MAIN HEAT EXCHGR
WATER INJECTOR
RAM AIR INLET ACTUATOR
RAM AIR INLET
RAM AIR OUTLET
SW
M
S

CONDENSER

FLOW CONTROL & PACK COMPONENTS D/O (3)

WATER EXTRACTOR AND INJECTOR

The air from the condenser is sent through the WATER EXTRACTOR. Guide vanes will supply this air at high speed and centrifugal forces will extract the water from the air flow. The extracted water is injected into the ram air duct through the WATER INJECTOR. This increases the cooling efficiency of the primary and main heat exchangers.
This is usually done only on ground or in low altitudes.

REHEATER

The air, which then contains almost no water, goes to the REHEATER. The REHEATER uses warm air from the main heat exchanger outlet to increase again the temperature of the cold air that comes from the water extractor. This is necessary to vaporize the last remaining water droplets before the air is sent to the ACM turbine and to prevent damage to the turbine.

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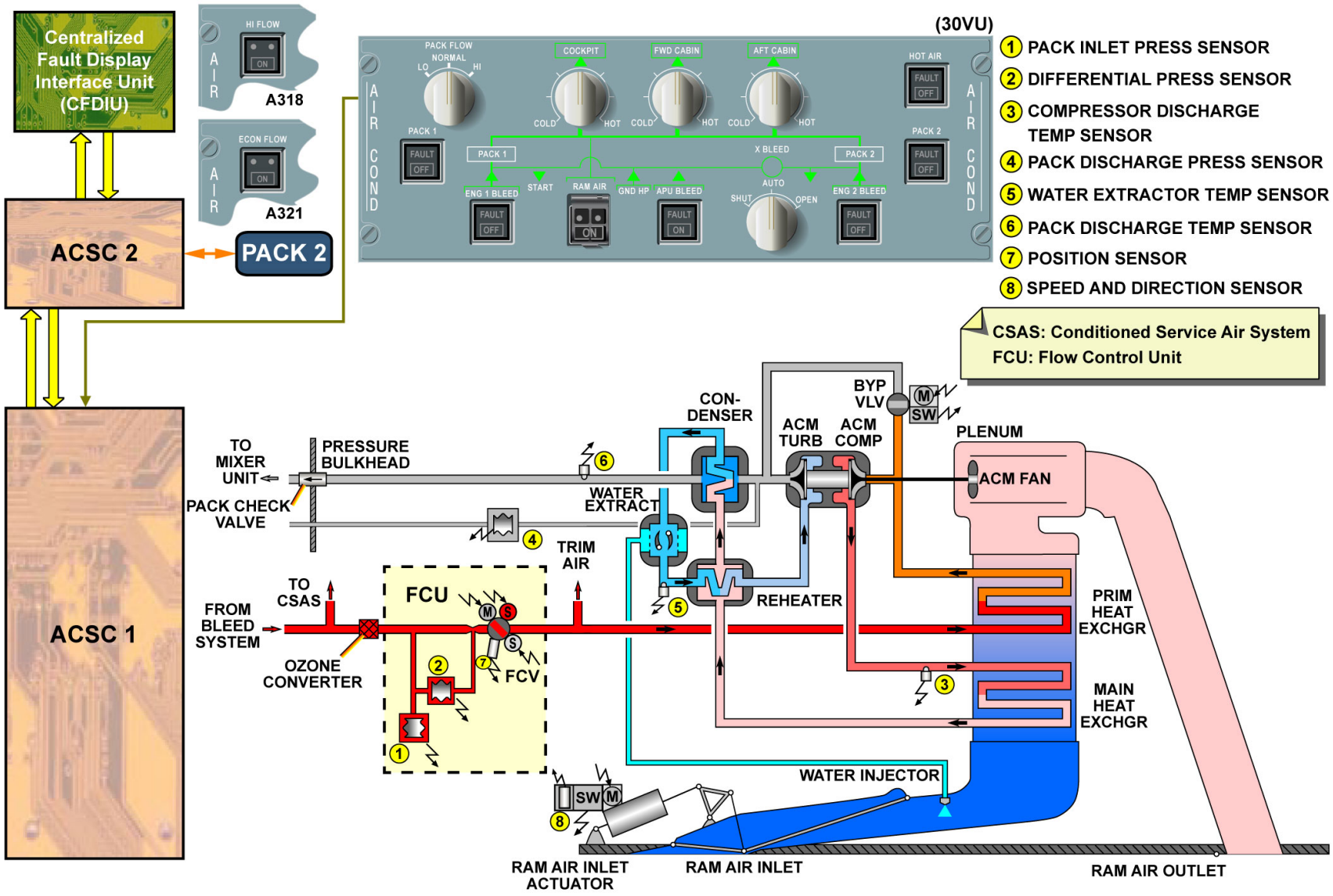

WATER EXTRACTOR AND INJECTOR & REHEATER

FLOW CONTROL & PACK COMPONENTS D/O (3)

AIR CYCLE MACHINE TURBINE

The ACM turbine converts high pressurized air into rotation and thus operates the ACM with its compressor and the ACM fan.
The result is a fast decrease of the air pressure and air temperature to below 0°C (-50°C as maximum negative temperature).

PACK DISCHARGE TEMPERATURE SENSOR AND CHECK VALVE

The cold air flows through the condenser again.
This cold airflow is used to decrease the temperature of the warm air to below the dew point before the air goes into the water extractor.
Downstream of the condenser, the ACSC uses the PACK DISCHARGE TEMPerature SENSOR to monitor the pack outlet temperature.
The sensor is used for indication on the ECAM COND page. A pack overheat warning will start at a temperature of more than 88°C.
The PACK CHECK VALVE, which is downstream of the condenser, stops leakage of air from the distribution system when the FCV is closed.
The check valve is attached to the pressure bulkhead of the forward fuselage.

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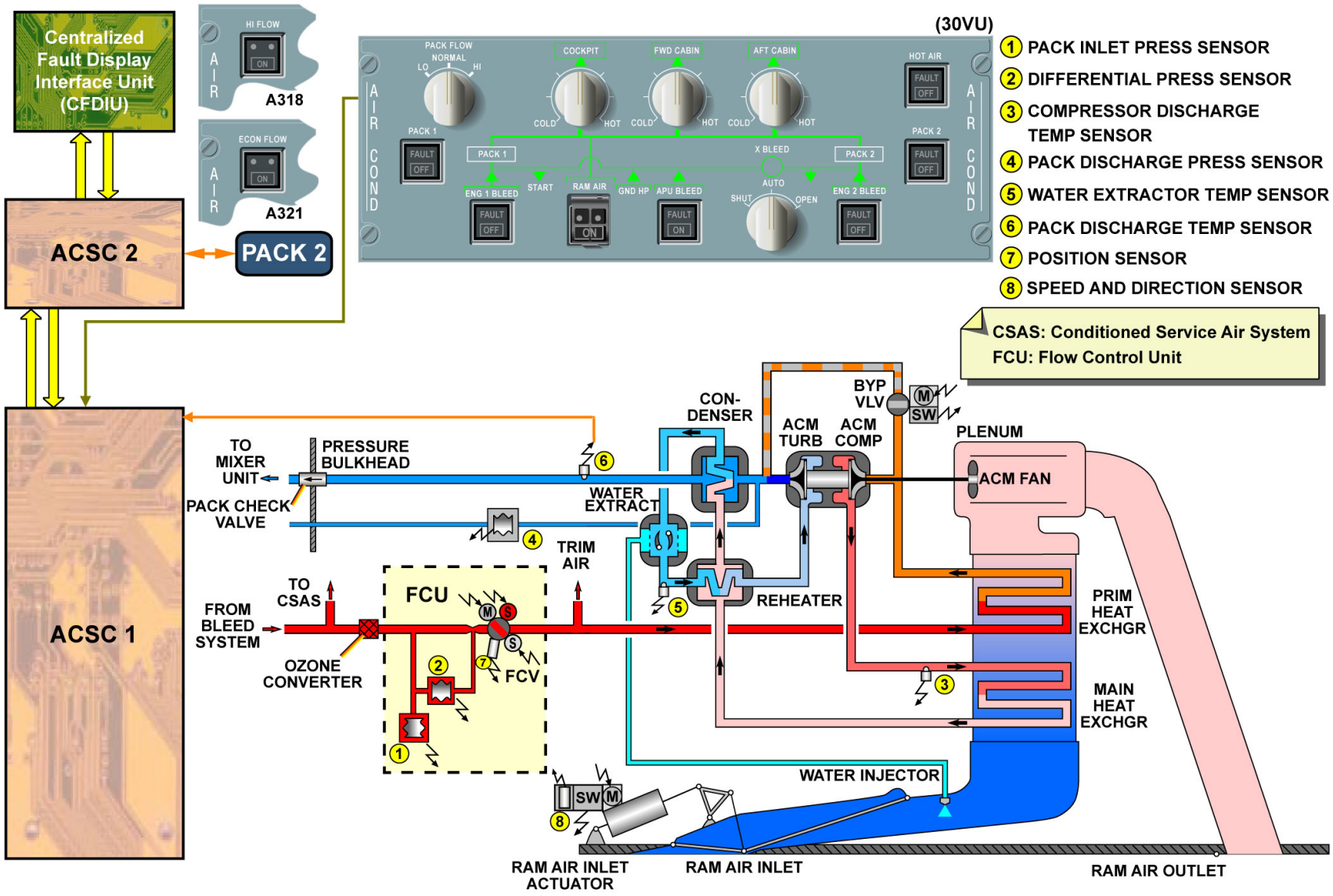

AIR CYCLE MACHINE TURBINE & PACK DISCHARGE TEMPERATURE SENSOR AND CHECK VALVE

FLOW CONTROL & PACK COMPONENTS D/O (3)

WATER EXTRACTOR TEMPERATURE SENSOR

The ACSC monitors the value from the WATER EXTRACTOR TEMP SENSOR to modulate the pack outlet temperature.

PACK TEMPERATURE CONTROL AND BYPASS VALVE

In relation to the input made by the pilots from panel 30VU and the related temperature selector, the ACSC compares the specified temperature with the sensed pack temperature. To adjust the temperature, the ACSC sends an electrical signal to the stepper motor of the Bypass Valve (BYP VLV). When controlled to a more open position, the valve bypasses hot air from the ACM compressor inlet around the ACM to the turbine outlet and thus increases the outlet temperature of the pack. This temperature control is used for short term and for a fast pack response.

RAM AIR ACTUATOR

For long term pack temperature control, the ACSC modulates the ram air cooling flow through the heat exchangers. To do this, it controls the position of the RAM AIR ACTUATOR and thus the position of the ram air inlet flap. The position of the ram air inlet flap is monitored by the SPEED AND DIRECTION SENSOR attached to the actuator.
In some special aircraft configurations (take-off and landing), the ram air flap is controlled to the fully closed position to prevent dirt ingestion from the nose landing gear.

ACM FAN

During aircraft operation on ground, the ACM FAN is used to supply cooling air around the primary and the main heat exchangers.
In flight with ram air available, the fan will be bypassed to prevent a negative effect on the ACM operation.

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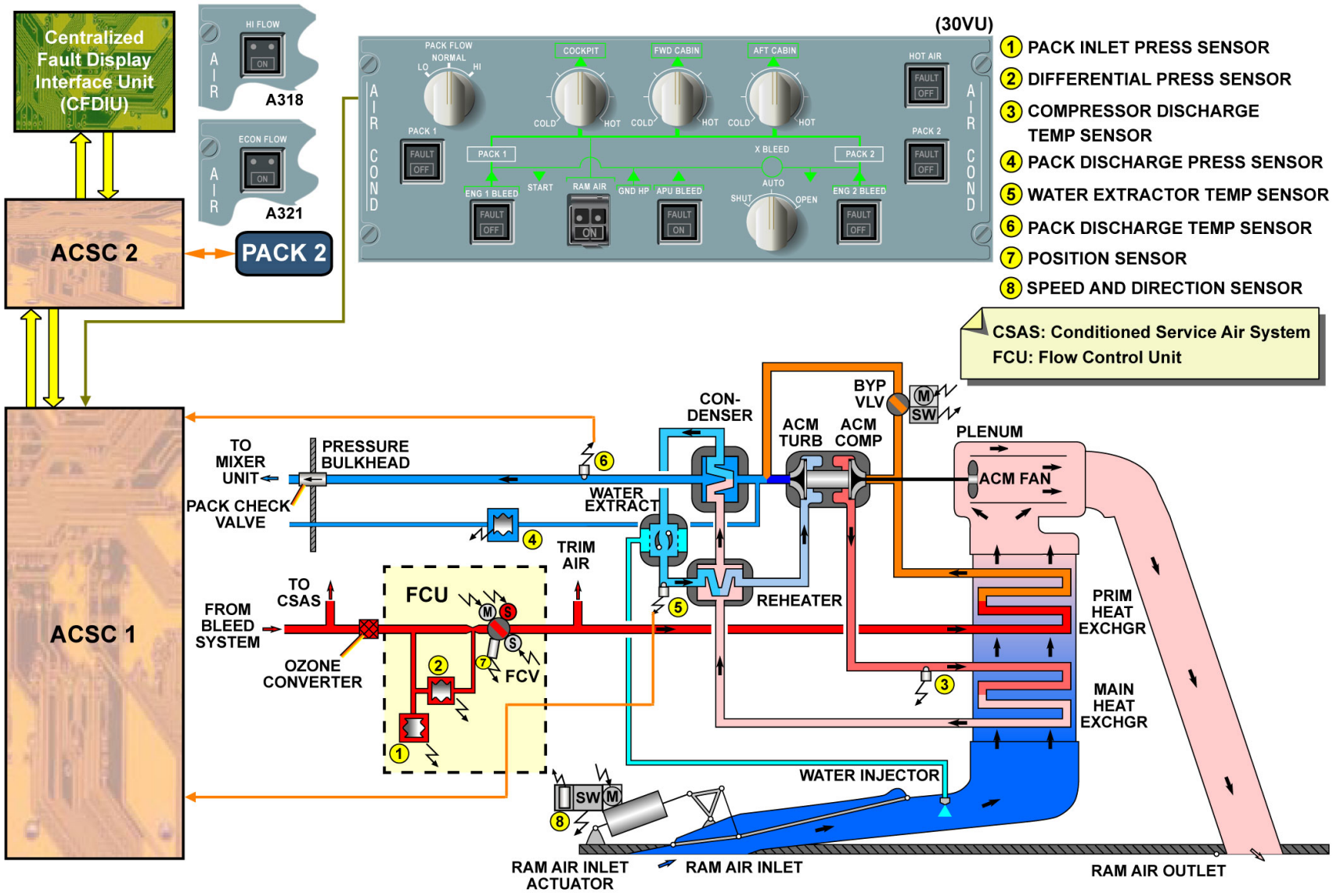

WATER EXTRACTOR TEMPERATURE SENSOR ... ACM FAN

FLOW CONTROL & PACK COMPONENTS D/O (3)

PACK DISCHARGE PRESSURE SENSOR

The ACSC uses the PACK DISCHARGE PRESS SENSOR to compare the cabin pressure with the turbine outlet pressure.
If the difference between these two pressure values is more than a specified limit, then there can be icing at the condenser
This causes the ACSC to command the bypass valve (BYP VLV) to a more open position and hot air flows directly into the turbine outlet airflow.
This hot air will melt the ice at the condenser, which causes the pack discharge pressure to get back to a normal value. When the pressure values are below the activation threshold, the bypass valve goes back to the normal temperature regulating position.

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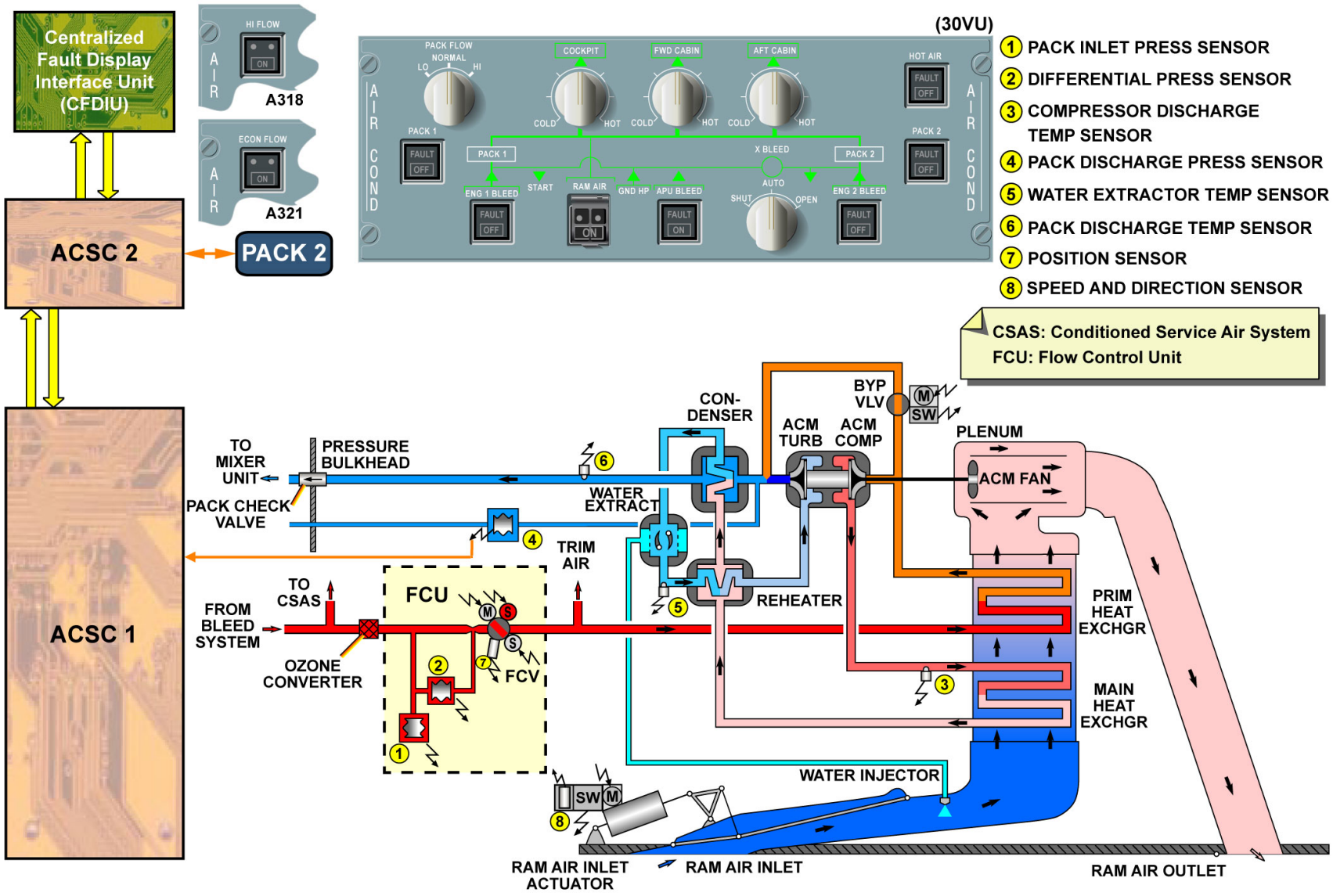

PACK DISCHARGE PRESSURE SENSOR

FLOW CONTROL & PACK COMPONENTS D/O (3)

PACK OVERHEAT DETECTION

To prevent a pack overheat, the ACSC monitors the COMPRESSOR DISCHARGE TEMP SENSOR.
The ACSC will send a signal to the RAM AIR INLET ACTUATOR if the temperature increases to more than 180°C.
This will cause an increase of the cooling airflow around the heat exchangers and an overheat condition will be prevented.
If there is no positive effect on the compressor outlet temperature, the ACSC will send a signal to the torque motor of the FCV to control it to a more closed position. This will decrease the hot air supply into the pack.
At a temperature of 260°C and with the aircraft on ground, the ACSC will close the FCV and send a signal to the panel 30VU. This signal causes the FAULT light in the related PACK pushbutton switch to come on. In flight, the FCV remains open. An ECAM warning will start.

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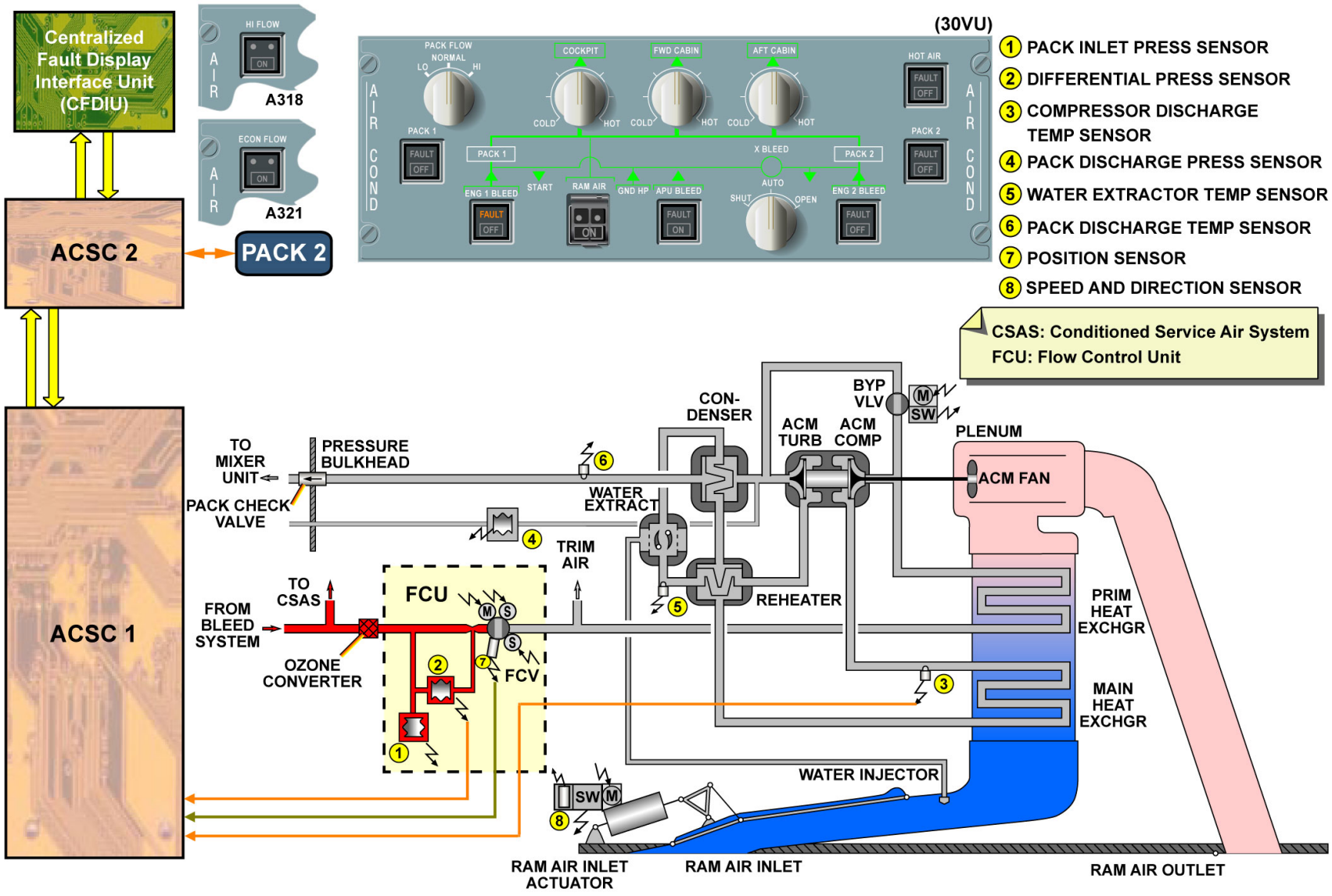

PACK OVERHEAT DETECTION

FLOW CONTROL & PACK COMPONENTS D/O (3)

MAINTENANCE

The Centralized Fault Display Interface Unit (CFDIU) is only connected to the ACSC 2. All BITE data of ACSC 1 will be transmitted to ACSC 2 first before it goes to the CFDIU.

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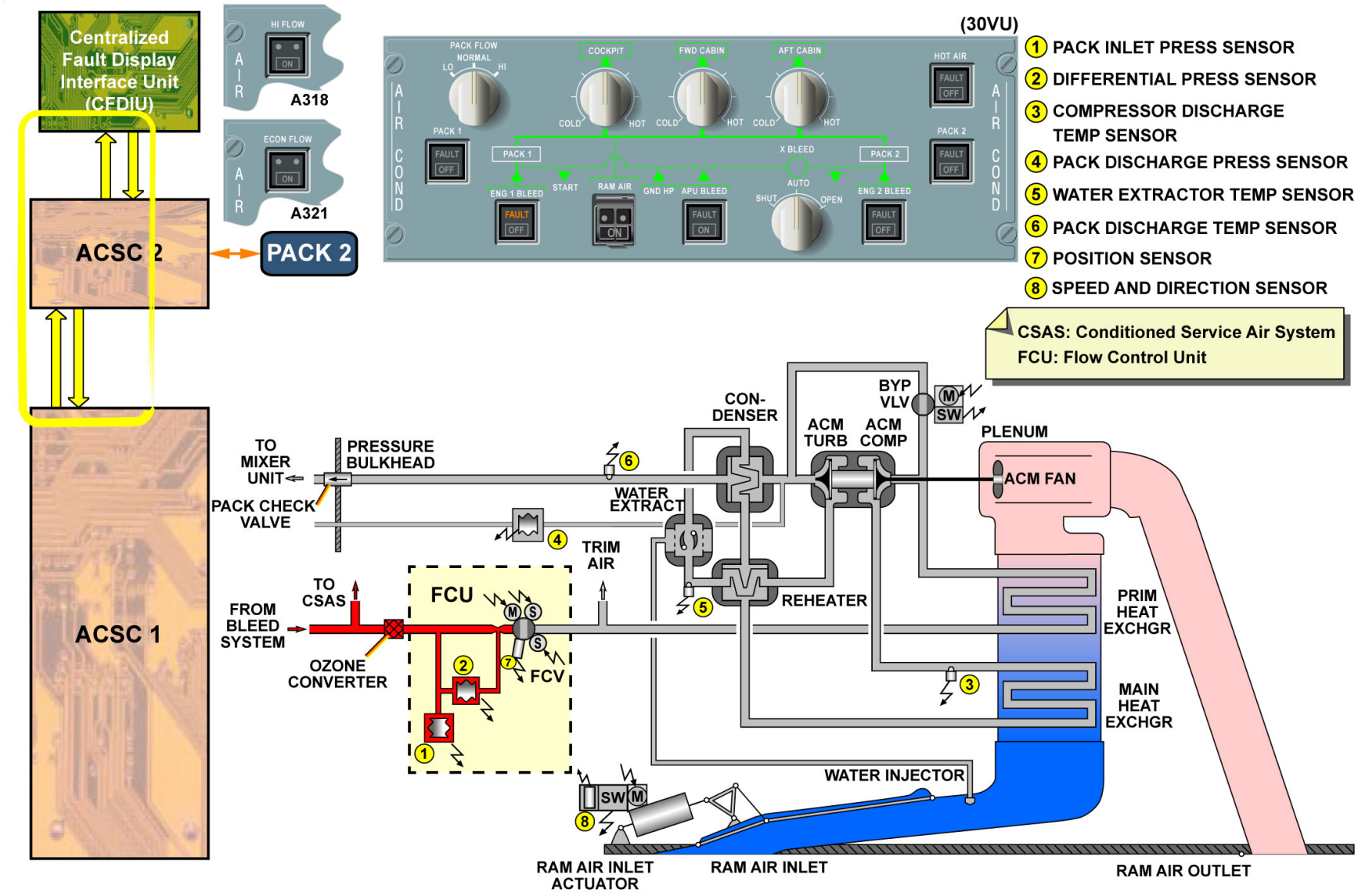

MAINTENANCE

PACK SENSORS DESCRIPTION/OPERATION (3)

PACK INLET PRESSURE SENSOR

The pack inlet pressure sensor signals a pack inlet pressure drop to the Air Conditioning System Controller (ACSC). It is used to determine the appropriate BYPass valve position. When the pack inlet pressure is low, the BYP valve is controlled to a more open position in order to decrease the Differential Pressure (DELTA P) of the air conditioning pack. At the same time, the ram air inlet flap is controlled to a more open position to compensate for the decreased efficiency of the turbine/compressor cycle. Also, when engines are idle, if the cooling demand cannot be satisfied, the engine idle setting can be changed by a thrust demand.

DELTA P SENSOR

A DELTA P sensor measures a differential pressure at the Flow Control Valve (FCV) inlet. This DELTA P, which is equivalent to the airflow, is converted into an electrical signal and sent to the ACSC. It is used for ECAM display and FCV control.

COMPRESSOR DISCHARGE TEMPERATURE SENSOR

The compressor discharge temperature sensor signals the compressor outlet temperature to the ACSC for pack temperature control and overheat detection.
Pack temperature control:
- up to 180°C (385°F): normal operation,
- 180°C to 220°C (428°F): the ram air inlet flap opens more in order to increase the RAM airflow.

The pack FAULT light comes on in if there is pack overheat of 260°C (500°F). If the A/C is on ground, automatic FCV closure occurs.

PACK DISCHARGE PRESSURE SENSOR

The pack discharge pressure sensor measures the pressure difference between turbine outlet and cabin underfloor pressure. The pack discharge pressure sensor is mounted on the bulkhead between the air conditioning bay and the pressurized cabin. It is connected to the corresponding ACSC.

WATER EXTRACT TEMPERATURE SENSOR

The water extract temperature sensor signals the water extractor temperature for the pack outlet temperature control. The pack temperature sensor has two thermistors: one sensing element is connected to lane 1 and the other to lane 2 of the related ACSC. They are used to modulate the pack outlet temperature.

PACK DISCHARGE TEMPERATURE SENSOR

The pack discharge temperature sensor signals the pack outlet temperature to the ACSC for ECAM display. The pack outlet temperature sensor also gives pack overheat warning indications if the pack outlet temperature exceeds 88°C (190°F).

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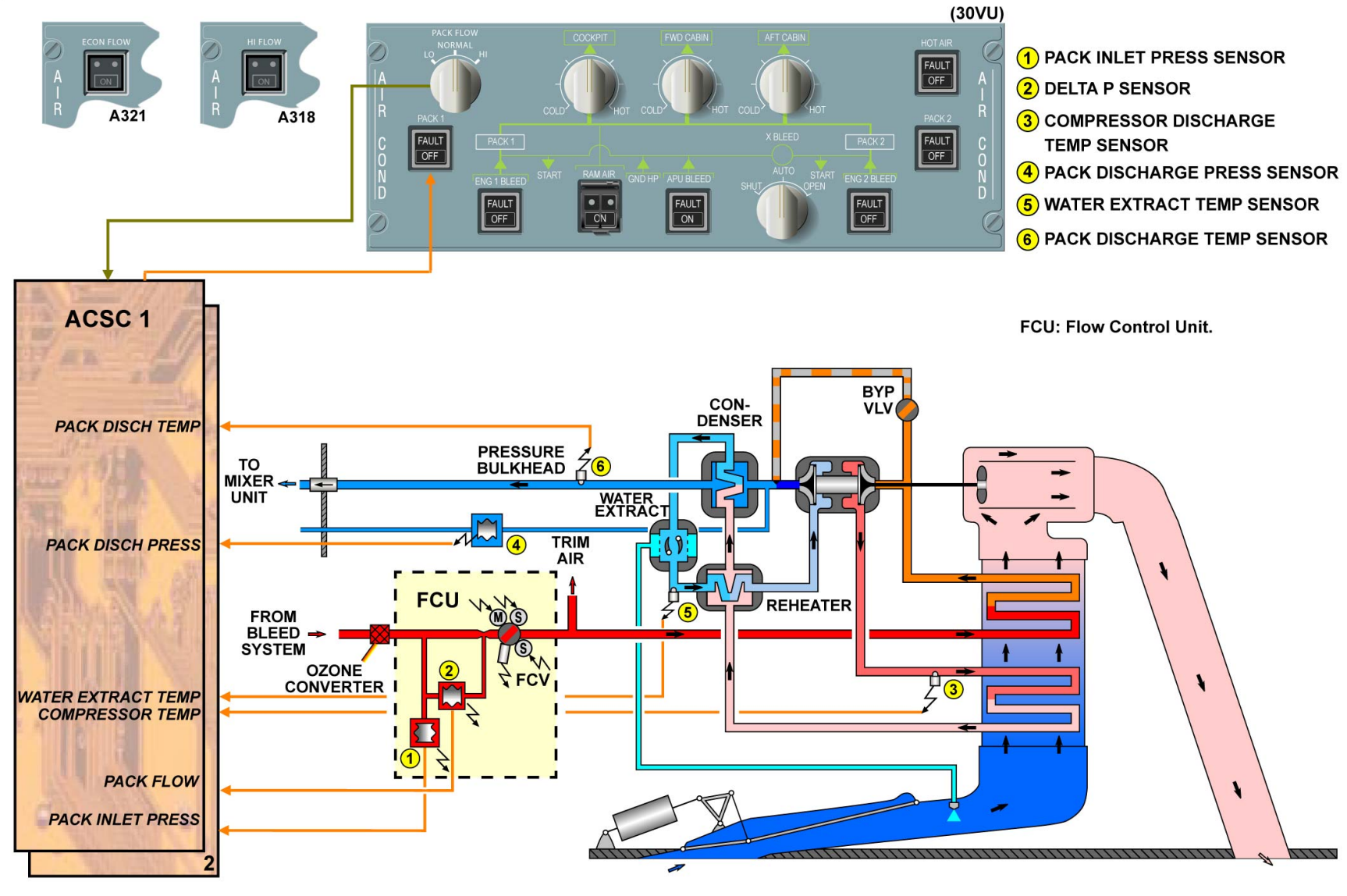

PACK INLET PRESSURE SENSOR ... PACK DISCHARGE TEMPERATURE SENSOR

COCKPIT & CABIN COMPONENTS D/O (3)

MIXER UNIT

The mixer unit mixes air from packs and recirculated air from the cabin before distribution to each zone. The mixer unit, installed under the cabin floor, uses cabin air, which has entered the underfloor area and has been drawn through recirculation filters by recirculation fans. This air is mixed with conditioned air from the packs. The quantity of cabin air mixed with conditioned air varies from 37% to 51% (the cabin fans operate at a constant speed, but the airflow from the Pack Flow Control Valve (FCV) can vary.)

TEMPERATURE SENSORS

There are two mixer unit temperature sensors, one on either side of the mixer unit. They give the actual temperature of the mixer unit to the Air Conditioning System Controllers (ASCSs). The cockpit mixer unit temperature sensor is connected to the ACSC 1 and the cabin mixer unit to the ACSC 2. Each mixer unit temperature sensor has two thermistors, one connected to lane 1 and the other to the second lane of the ACSC.

MIXER UNIT FLAP

The mixer unit flap ensures sufficient flight deck air supply if pack 1 is selected off. An electrically operated mixer unit flap is installed to ensure that sufficient fresh air is delivered to the cockpit in case of pack 1 failure.

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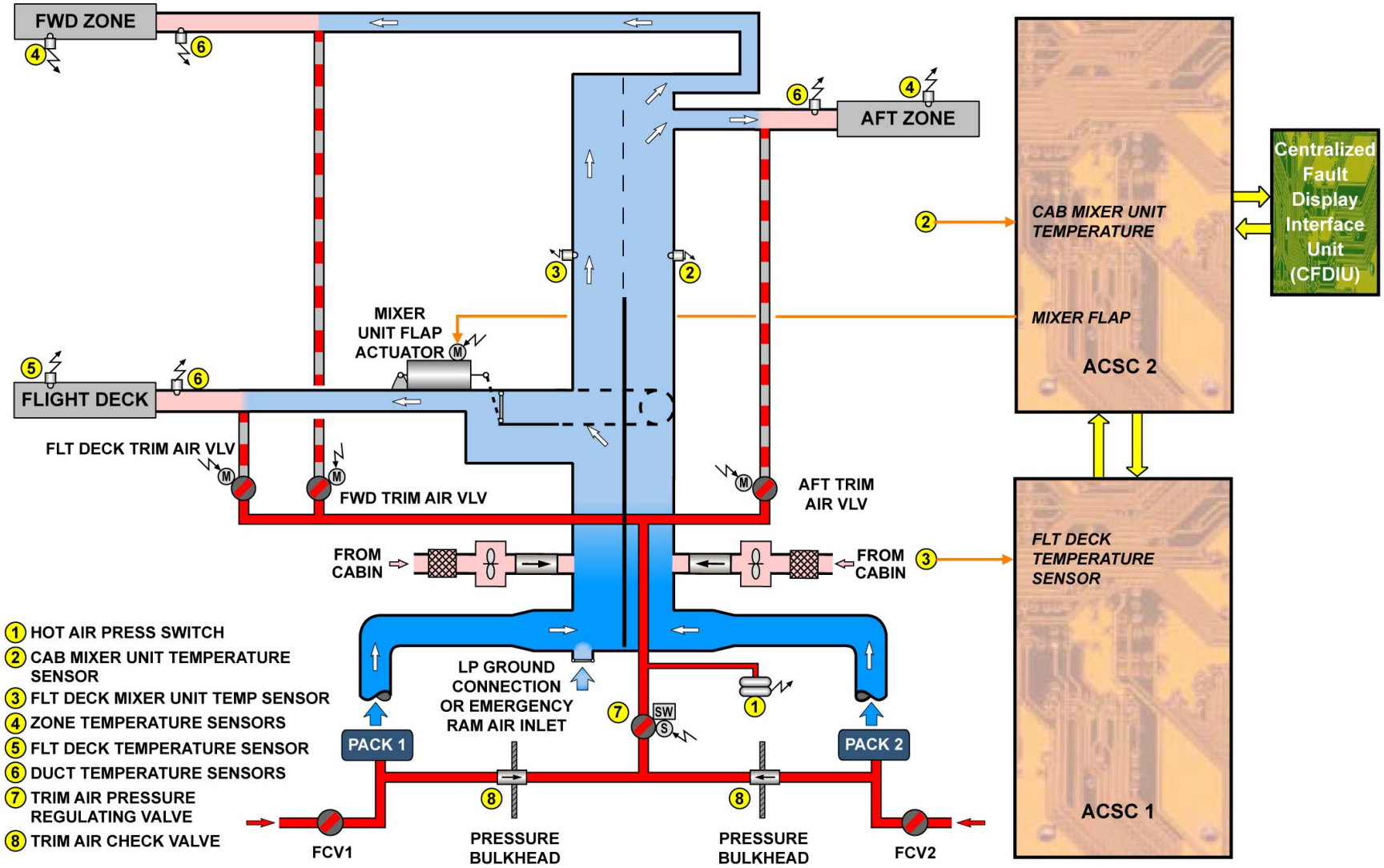

MIXER UNIT ... MIXER UNIT FLAP

COCKPIT & CABIN COMPONENTS D/O (3)

AIR CONDITIONING SYSTEM CONTROLLERS

During normal or abnormal operation the cockpit and cabin system is controlled by the two ACSCs. Cabin zones demanding a higher temperature than that which is available from the mixer unit receive additional hot trim-air added by the trim air valve. The trim air valves are operated by ACSC 1 for the cockpit and ACSC 2 for the FWD and aft cabin zones.

TRIM AIR PRV

The trim air Pressure Regulating Valve (PRV) is pneumatically operated and electrically controlled by a solenoid. The solenoid controls the ON/OFF function. The trim air PRV regulates the pressure of the air supplied to the trim air valves, 4 psi above the cabin pressure. The ON/OFF function solenoid de-energizes when the HOT AIR P/B is set to OFF or when the temperature of any duct is above 88°C (190°F). This closes the valve.

HOT AIR PRESSURE SWITCH

Due to a malfunction of the trim air PRV, the hot air pressure switch signals overpressure to ACSCs 1 and 2 for ECAM display and the Centralized Fault Display System (CFDS) and monitoring. If pressure in the system is 6.5 psi greater than the cabin pressure, ACSC 1 sends a fault signal to ECAM. This signal stays until the pressure falls below 5 psi.

TRIM AIR VALVES

The trim air valves lets the zone temperature be adjusted by modulating the hot airflow added to air from the mixer unit. The trim air valves close when the trim air PRV closes. The butterfly of the trim air valves is controlled by a stepper motor. The trim air valve position is determined using the step-counting principle.

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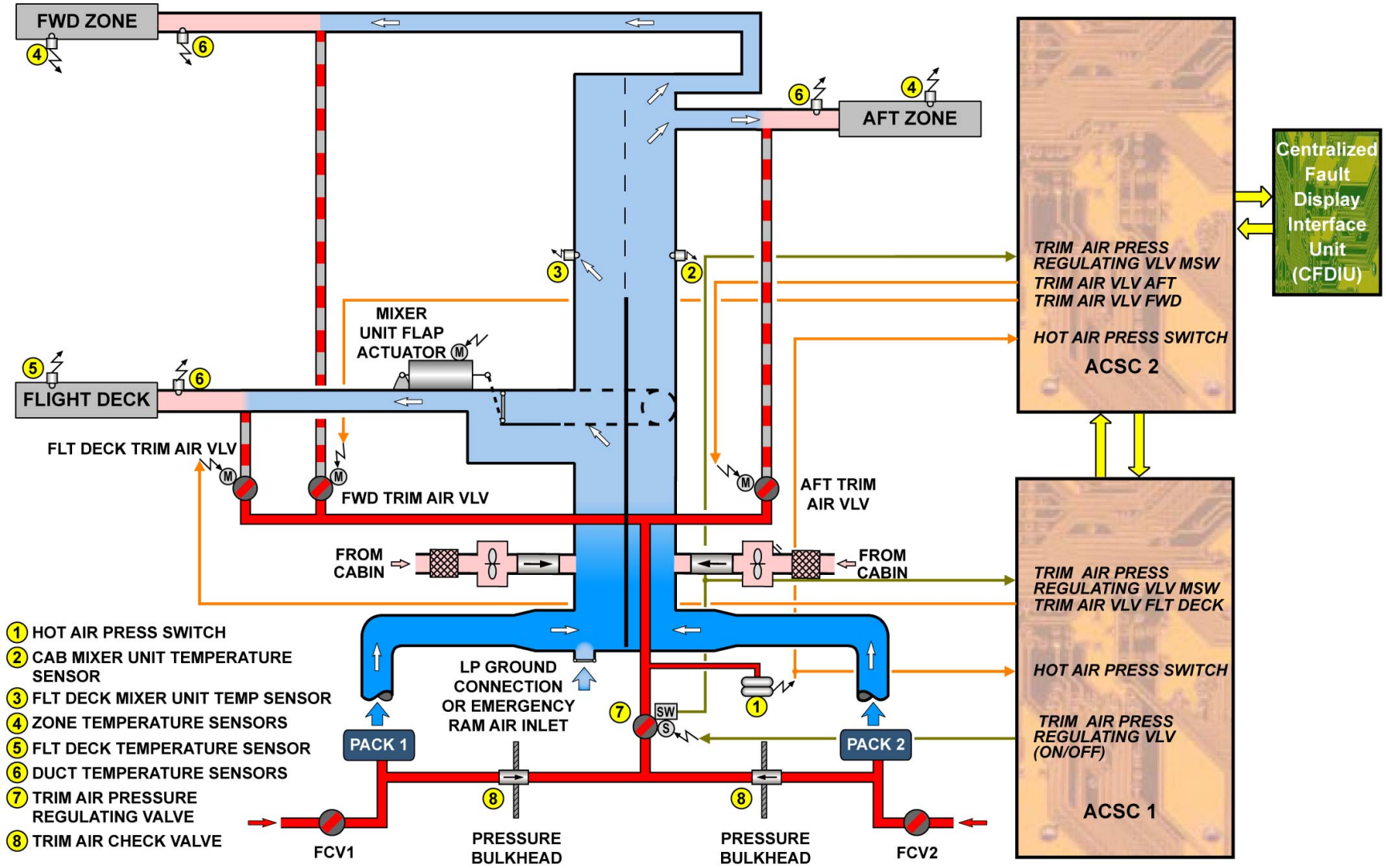

AIR CONDITIONING SYSTEM CONTROLLERS ... TRIM AIR VALVES

COCKPIT & CABIN COMPONENTS D/O (3)

DUCT TEMPERATURE SENSORS

Each duct temperature sensor detects duct temperature for the related zone temperature control, indication and overheat detection to the ACSC. Each duct temperature sensor has two thermistors, one connected to lane 1 and the other to the second lane of the ACSC. Each thermistor does control, indication and overheat detection 88°C (190°F).
In case of overheat in one of the three supply ducts (temperature above 88°C or 190°F), the ACSCs close the trim air PRV and all Trim Air Valves (TAV) automatically.

ZONE TEMPERATURE SENSORS

Each zone sensor detects the related zone temperature for zone temperature control and indication on ECAM display. Each zone temperature sensor has two thermistors, one connected to ACSC 1 and the other to ACSC 2.

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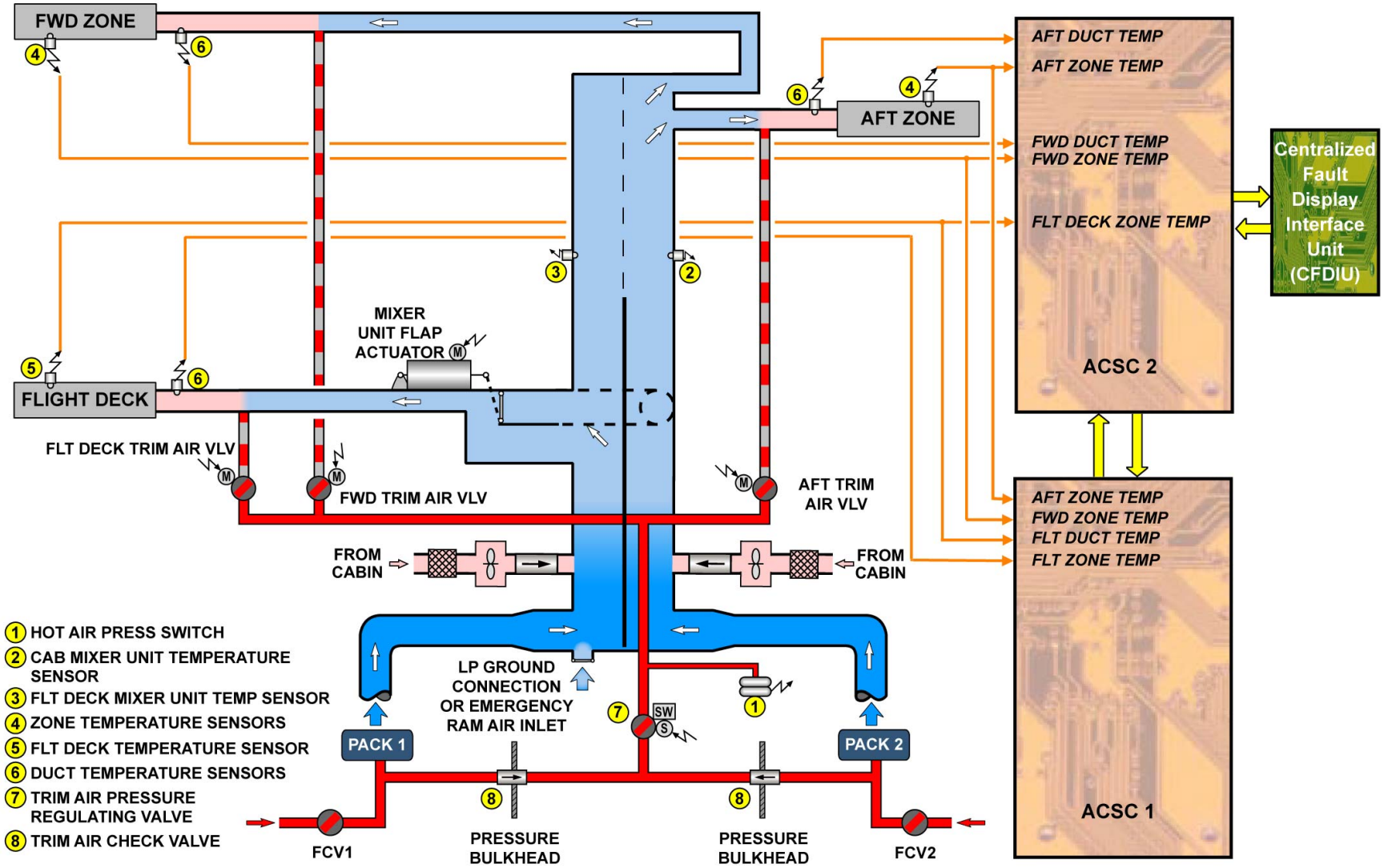


DUCT TEMPERATURE SENSORS & ZONE TEMPERATURE SENSORS

ZONE TEMPERATURE CONTROL INTERFACES (3)

GENERAL

The function of the Air Conditioning System Controller (ACSC) is to communicate with other systems via hardware interfaces.

SDAC

System data information is transmitted to the System Data Acquisition Concentrator (SDAC) via ARINC buses for system monitoring. The system data information is used for warning and display. These data are temperature, valve position and others.

EIU

The ACSC sends data to both Engine Interface Units (EIUs). Each EIU sends one discrete to the ACSC. EIUs 1 and 2 send to the ACSC:
- the take-off thrust used for pack ram air inlet closure,
- the High Pressure (HP) fuel valve position used for bleed demand circulation and for engine start sequence, so that the pack Flow Control Valves (FCVs) are controlled to close during engine start.

The ACSC sends to EIUs 1 and 2:
- the engine power increase used for bleed airflow increase,
- the bleed and the anti-ice status used for thrust limit calculation.

CPC

The Cabin Pressure Controller (CPC) 1 or 2 (depending who is in control) sends data to the ACSC for zone and pack temperature control. The A/C altitude is used for zone temperature compensation and pack water extractor outlet temperature limitation.

ECB

The ACSC sends data to the Electronic Control Box (ECB) and receives an APU bleed valve open discrete. The ACSC sends to the ECB the increase of APU flow used for increased bleed airflow.
When the ECB sends a signal to the ACSC, the APU bleed valve open discrete is used for flow demand calculation.

FDIMU

The ACSCs send system main status data to the Flight Data Interface and Management Unit (FDIMU) for maintenance monitoring functions.
The ACSC sends to the FDIMU:
- the trim-air Pressure Regulating Valve (PRV) position,
- pack flow, water extractor and pack compressor discharge temperatures, BYPass valve and ram air inlet flap positions.

CFDIU

ACSC 2 sends BITE data to the Centralized Fault Display Interface Unit (CFDIU) for system monitoring. The BITE data is used for temperature control system monitoring.
Only the ASCS 2 is connected to the CFDIU. Therefore all BITE data from/to ACSC 1 are transmitted through the ACSC 2.

AIR CONDITIONING SYSTEM CONTROLLERS

The ACSCs mainly receive temperature and flow demands, CFDIU control signals and send back maintenance data signals. The ACSCs also receive a signal from the DITCHING P/B to close both pack FCVs if there is a ditching. ACSC 1 and 2 receive a signal from the engine FIRE P/B, to close the related pack FCV in case of engine fire. The Cabin Intercommunication Data System (CIDS) Director 1 sends a data signal for ACSC 1, and the CIDS Director 2 sends a signal for ACSC 2 for

temperature regulation (+ or - 2.5°C) from the Flight Attendant Panel (FAP).

FAN PARAMETERS

The ACSCs receive discrete signals from recirculation and toilet fans for monitoring. The lavatory and galley extraction and the cabin recirculation fan operation are used for monitoring and transmission to the SDACs and CFDIU.

ANTI-ICE AND PNEUMATIC PARAMETERS

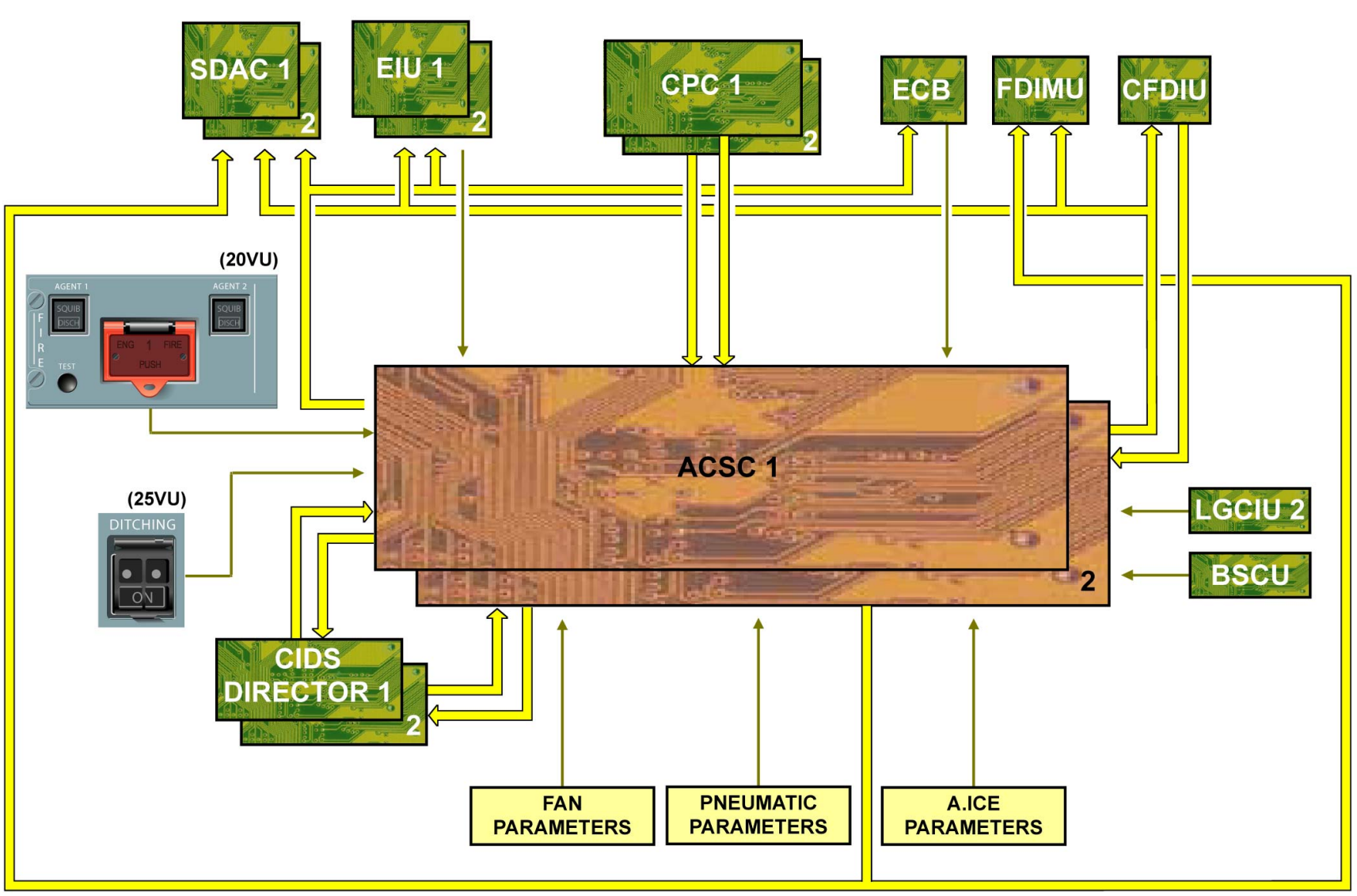
Anti-ice and pneumatic parameters are used to detect faults and to make sure that the status of the bleed air system is transmitted to the CFDIU and EIUs. The valve positions, low and high pressure, are used for anti-ice system fault detection for the CFDIU and thrust limit calculation for the EIUs.

LGCIU 2

Landing Gear Control and Interface Unit (LGCIU) 2 sends a ground/flight signal to both ACSCs for pack air inlet flap operation. The ground/flight signal is used for pack ram air inlet flap closure during take-off and landing phases.

BSCU

The Braking/Steering Control Unit (BSCU) sends a wheel signal to both ACSCs for pack ram air inlet flap operation. The wheel speed is used for pack ram air inlet flap closure during take-off and landing phases.



GENERAL ... BSCU

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EMERGENCY RAM AIR INLET D/O (3)

GENERAL

The A/C has one emergency ram air inlet flap located at the lower LH side of the fuselage, sharing the same duct with the LP ground connection.

EMERGENCY RAM AIR INLET FLAP OPERATION

In case of failure of both packs in flight or a smoke removal in flight, an emergency ram air inlet flap can be opened for A/C ventilation. In case of smoke removal or loss of both packs, the RAM AIR P/B must be set to ON. When set to ON, and if DITCHING is not selected, the emergency ram air inlet flap opens. The flap, installed between the LP GND connection and ram air inlet, closes one side of the Y-duct when air is supplied from the other side. The check valve stays closed. The A/C must descend to less than 10000 ft. When the cabin differential pressure is less than 1 psi, the Cabin Pressure Controller in control half opens the outflow valve. The air then goes through the check valve to the mixing unit.

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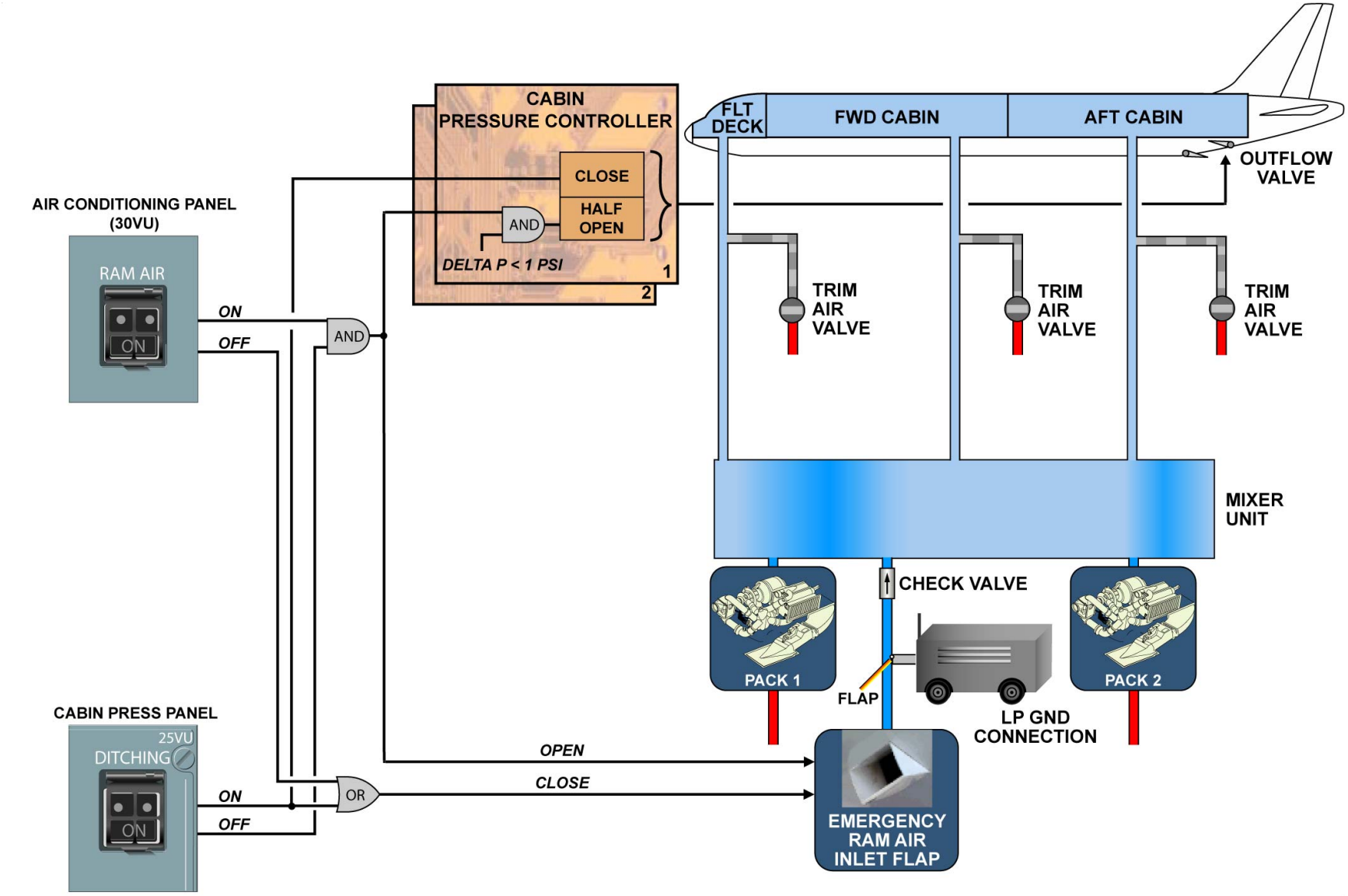

GENERAL & EMERGENCY RAM AIR INLET FLAP OPERATION

SYSTEM PRESENTATION (3)

CABIN PRESSURE ALTITUDE ENVELOPE

The cabin altitude is limited to 8000 ft with a DELTA P of 8.06 psi for an A/C altitude of 39000 ft. If cabin altitude increases:
- at 9550 ft, the MASTER WARN comes on,
- at 11300 ft, passenger signs are activated.

In the outflow valve, a safety device closes the valve when the cabin altitude reaches 15000 ft.
Under normal conditions, the LanDing field ELEVation selector is selected in the AUTO position enabling the CPCs to use the landing field elevation data from the FMGS. In all other cases the LDG ELEV selector signal overrides the FMGS data (semi-automatic operation). A DITCHING pushbutton switch closes the outflow valve in ditching configuration.

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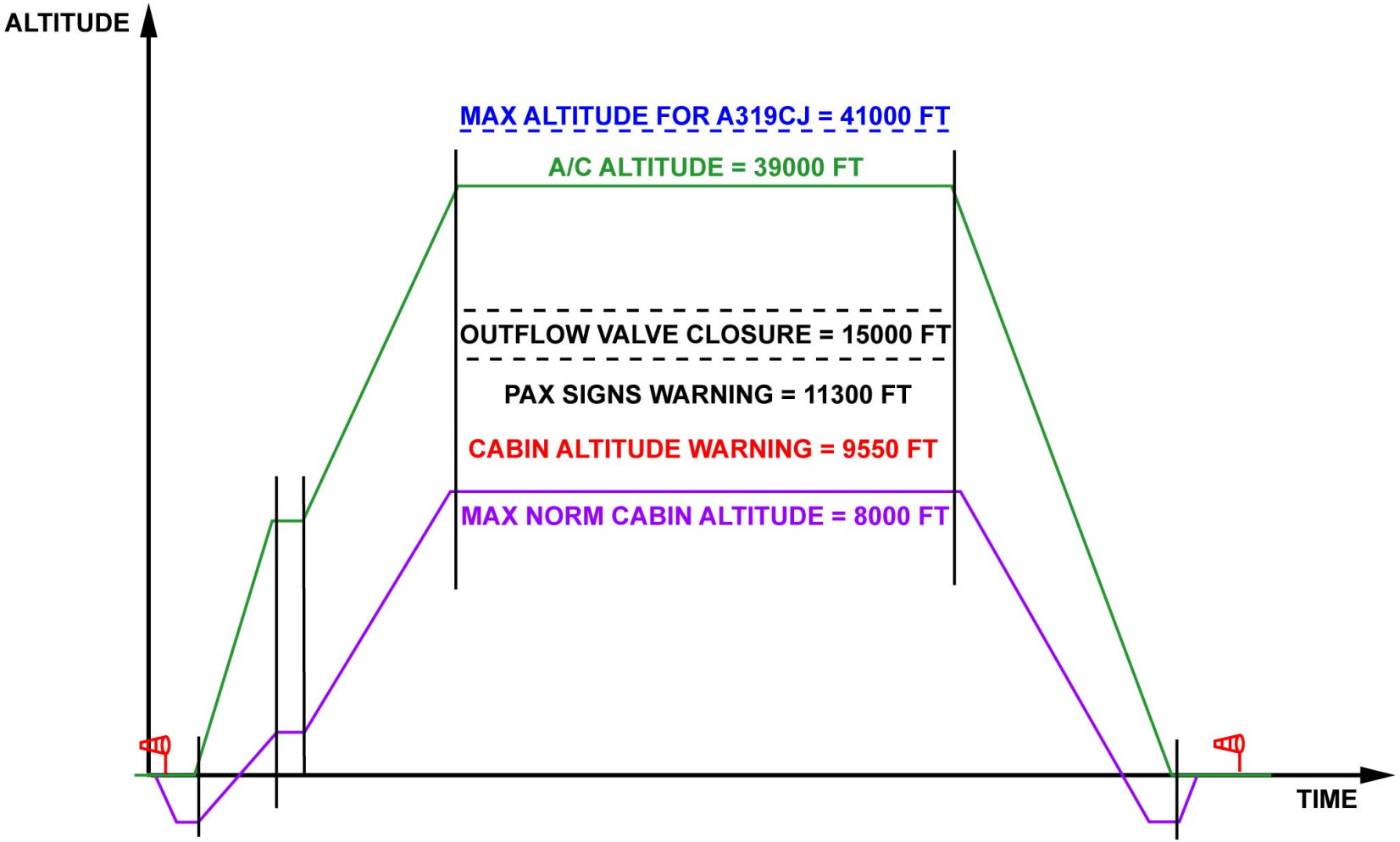

ALTITUDE
MAX ALTITUDE FOR A319CJ = 41000 FT
A/C ALTITUDE = 39000 FT
OUTFLOW VALVE CLOSURE = 15000 FT
PAX SIGNS WARNING = 11300 FT
CABIN ALTITUDE WARNING = 9550 FT
MAX NORM CABIN ALTITUDE = 8000 FT
TIME

CABIN PRESSURE ALTITUDE ENVELOPE

UGB13131 - U7ST0M0 - UM21P3000000001

SYSTEM PRESENTATION (3)

CABIN PRESSURE CONTROLLERS

There are two interchangeable controllers, which are identified as Cabin Pressure Controller (CPC) 1 and CPC 2 by means of pin programming. Each controller has an automatic and manual part which are functionally and electronically independent of each other. One controller operates the system at a time according to flight profile data and A/C configurations. The second controller is in active stand-by with automatic changeover after each flight or in case of failure of the active one.
The CPCs inputs are:
- flight profile data: Flight Management and Guidance System (FMGS), Air Data/Inertial Reference System (ADIRS), Centralized Fault Display System (CFDS),
- A/C configurations: Engine Interface Unit (EIU), Landing Gear Control and Interface Unit (LGCIU), Environmental Control System (ECS).
The CPCs outputs data for indicating and monitoring are: Flight Warning Computer (FWC), System Data Acquisition Concentrator (SDAC), CFDS, ECS, Aircraft Integrated Data System (AIDS).
When manual mode is used, the manual part of controller 1 operates only as a back-up indication circuit processing outputs for indicating and monitoring. CPC 1 manual part outputs for monitoring and indicating are: FWC and SDAC. CPC 2 manual part is not used.

OUTFLOW VALVE

In automatic mode, the outflow valve is controlled by the operating controller. The outflow valve is of the double flap and motor driven type. In automatic operation, the outflow valve is operated by electronics module 1 or module 2 depending on the operating controller:
- electronics module 1 is controlled by controller 1, controller 1 plus motor 1 are linked to system 1,
- electronics module 2 is controlled by controller 2, controller 2 plus motor 2 are linked to system 2.

Two electronic actuators interface with the controllers. A pressure switch, which only operates in automatic mode, is installed in each electronic actuator. It closes the applicable outflow valve in case of cabin altitude above 15000 ft. Motor 3 is controlled from the CABIN PRESSure panel by the MANual Vertical/Speed ConTroL toggle switch when manual mode is selected on the MODE SELection P/B. The manual motor is used in case of failure of systems 1 and 2.
The outflow valve position monitoring is based on a triple potentiometer principle. Potentiometer 1(2) generates a feedback signal, sent to CPC 1(2) through electronic actuator 1(2). It is used for indication and initialization functions in automatic operation. Potentiometer 3 generates a feedback signal, sent straight to the CPC 1 manual backup part. It is used as indication function in manual operation only.

SAFETY VALVES

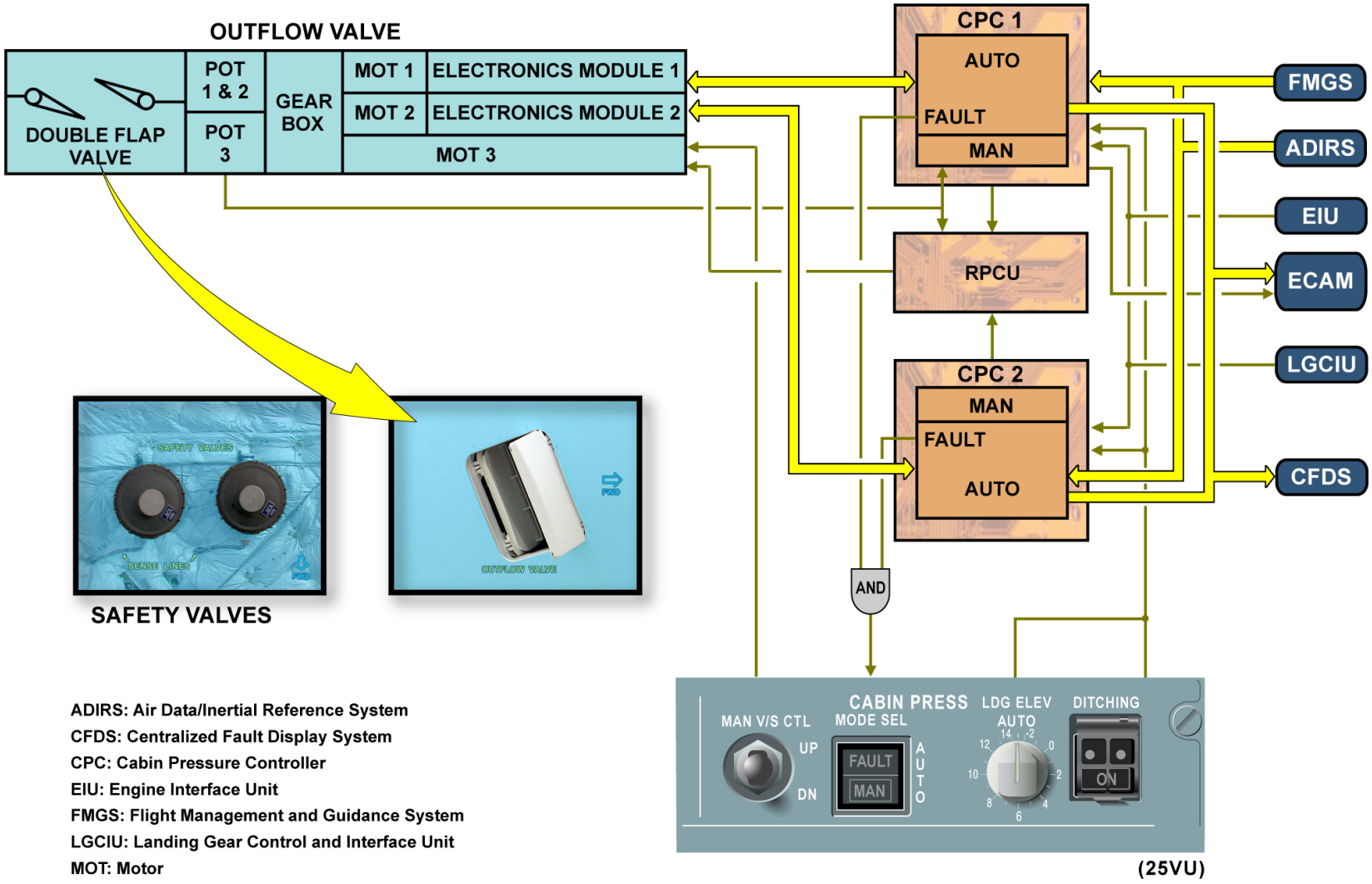
The safety valves prevent excessive positive and negative differential pressure (DELTA P) in the fuselage. They are installed on the aft pressure bulkhead above the A/C flotation line. The safety valves are poppet-type pneumatic valves. They operate independently.

RPCU

The RPCU interfaces with the CPCs and takes over the control of the outflow valves automatically if the outflow valve is not in the fully open position when the aircraft is on ground. This is to prevent any door violent opening in case of residual cabin pressure.
The control of the Outflow Valve (OFV) by the Residual Pressure Control System (RPCU) is done through the MOT 3, when the following situation is detected:
- both main landing gears are compressed, or one main landing gear is compressed and the Parking Brake is set to ON, and
- both Master Switches are in OFF or speed is below 100 knots
AND

- outflow valve is not fully open, and
- cabin pressurization system is in manual mode or both CPCs are inoperative.

In these cases, the OFV is driven to the fully open position by the RPCU.



ADIRS: Air Data/Inertial Reference System
CFDS: Centralized Fault Display System
CPC: Cabin Pressure Controller
EIU: Engine Interface Unit
FMGS: Flight Management and Guidance System
LGCIU: Landing Gear Control and Interface Unit
MOT: Motor
POT: Potentiometer
RPCU: Residual Pressure Control Unit

CABIN PRESSURE CONTROLLERS ... RPCU

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SYSTEM CONTROL INTERFACES (3)

EIU

Each Engine Interface Unit (EIU) sends a thrust lever angle associated with an N2 signal to both controllers to initiate the pre-pressurization and the pressurization sequences.
The signals are:
- Thrust lever angle in Takeoff (TO) position,
- MAXimum CONTinuous or FLeXible detent,
- N2 at or above idle, used for pre-pressurization and pressurization sequences.

LGCIU

Each Landing Gear Control and Interface Unit (LGCIU) sends a flight/ground signal to both controllers to initiate pre-pressurization, pressurization and depressurization sequences. The ground/flight signal is used for pre-pressurization, pressurization, depressurization sequences and system transfer.

ADIRU

Each Air Data/Inertial Reference Unit (ADIRU) sends the static pressure and the barometric correction signals to both controllers for pressure control.
These signals are:
- Static pressure,
- BARO (barometric) correction,
- ADIRU validity, used for all sequences and priority selection.

ADIRU 1, 2, 3 sends signals to controller 1 and ADIRU 2, 1, 3 sends signals to controller 2.

FMGC

Each Flight Management and Guidance Computer (FMGC) sends cruise flight level and landing field elevation data to both controllers.
The signals are:
- Cruise flight level,
- Landing field elevation, used for pressurization profile.

MOTORS

A discrete signal from the active controller will select the corresponding motor and enable signal, while outflow valve positioning and monitoring signals are transmitted by RS 422 buses.
The signals in AUTO MODE are:
- "enable signal" to motor in control,
- outflow valve positioning and monitoring.

In MANUAL MODE, the feedback position from motor 3 is sent to controller 1.
The Residual Pressure Control Unit (R
PCU)
controls the residual pressure in the cabin and takes over the control of the outflow valve automatically by providing power directly to the manual motor (motor 3).

CONTROLLER 1/CONTROLLER 2

Discrete signals between both controllers ensure controller transfer. The system 1 or 2 active signal is used for controller transfer.

AIR COND PANEL AND CABIN PRESS PANEL

The position of the pressure panel switches and emergency RAM AIR switch is transmitted to both controllers.
The CABIN PRESSurization panel signals are:
- ditching,
- landing field elevation selection,
- manual mode selection, used for manual operation.

The AIR CONDitioning panel signal is the emergency ram air inlet selection, used for outflow valve half opening.

PRESS PANEL/MOTOR 3

Motor 3 is controlled by a discrete signal directly sent by the CABIN PRESS panel. This signal is used for manual mode.

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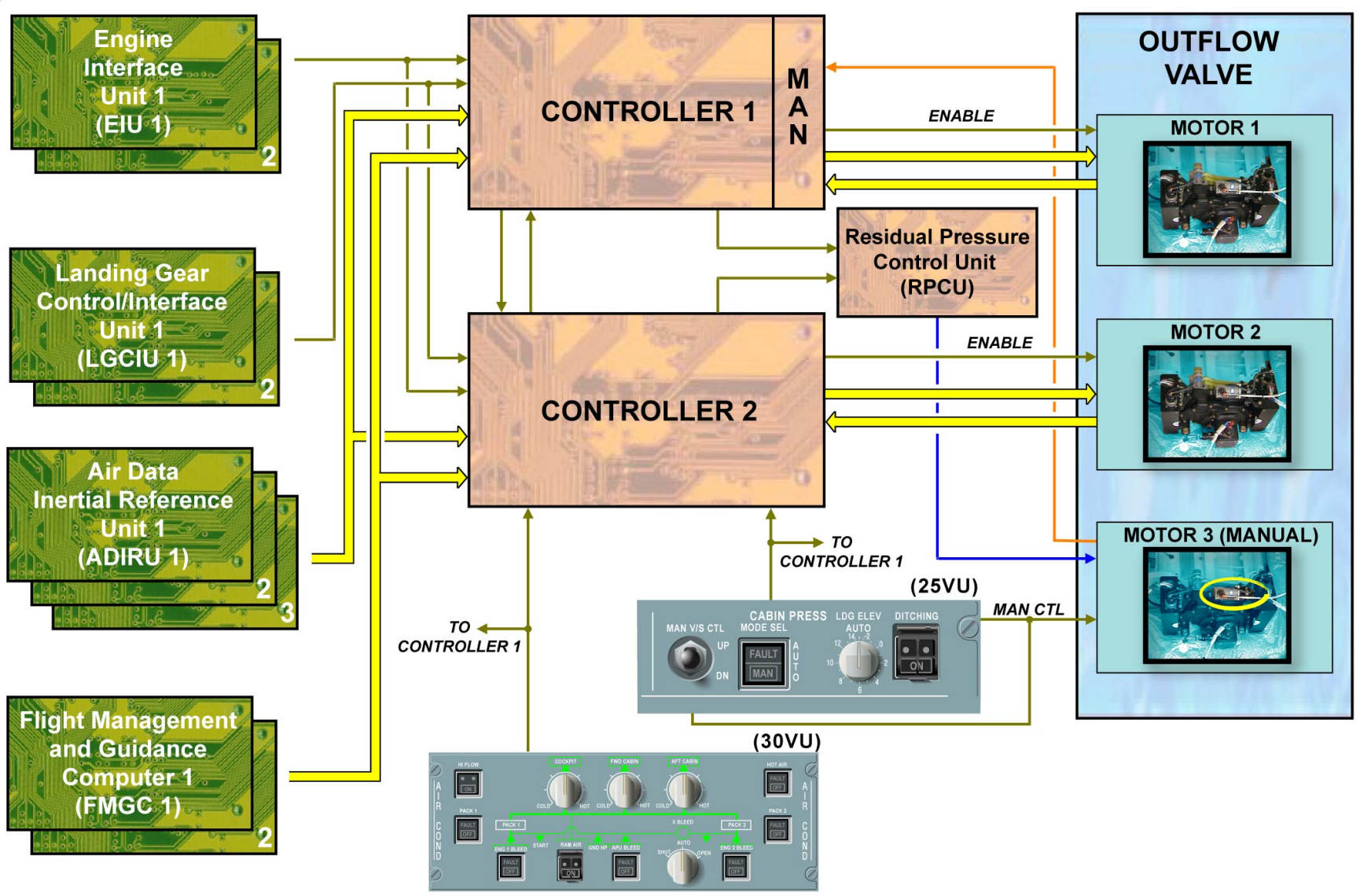

EIU ... PRESS PANEL/MOTOR 3

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SYSTEM CONTROL INTERFACES (3)

RPCU INTERFACES

The Residual Pressure Control Unit (RPCU) has the following Interfaces:
- Engine Interface Units (EIUs) send the position of the related Engine Master Switch (ON / OFF),
- Landing Gear Control / Interface Units (LGCIUs) send the signal for the LH / RH main landing gear compressed condition
- Air Data Inertial Reference Units (ADIRUs) send aircraft speed below or above 100 knots,
- Parking Brake Control Relay sends the signal Parking Brake set to ON or OFF

These inputs determine the A/C condition at gate and are used to satisfy RPCU control logics

The Residual Pressure Control Unit (RPCU) has other interfaces:
- MODE SEL P/B on the CABIN PRESS panel 25VU detects if the cabin pressure control system is in manual mode
- Cabin Pressure Controller 1 (CPC) signals if the CPC 1 is operative or inoperative
- Outflow Valve (OFV) position of the potentiometer 3 (sent to the MANual part of CPC 1) detects if the OFV is 100% open or not
- Cabin Pressure Controller 2 (CPC) signals if the CPC 2 is operative or inoperative

These inputs determine if the RPCU needs to control the OFV to the fully open position. Therefore the RPCU sends a direct signal to MOTOR 3 to open the OFV.

The RPCU sends a discrete signal to the CFDIU for fault information (ok or not ok), which leads to a class 3 fault indication.

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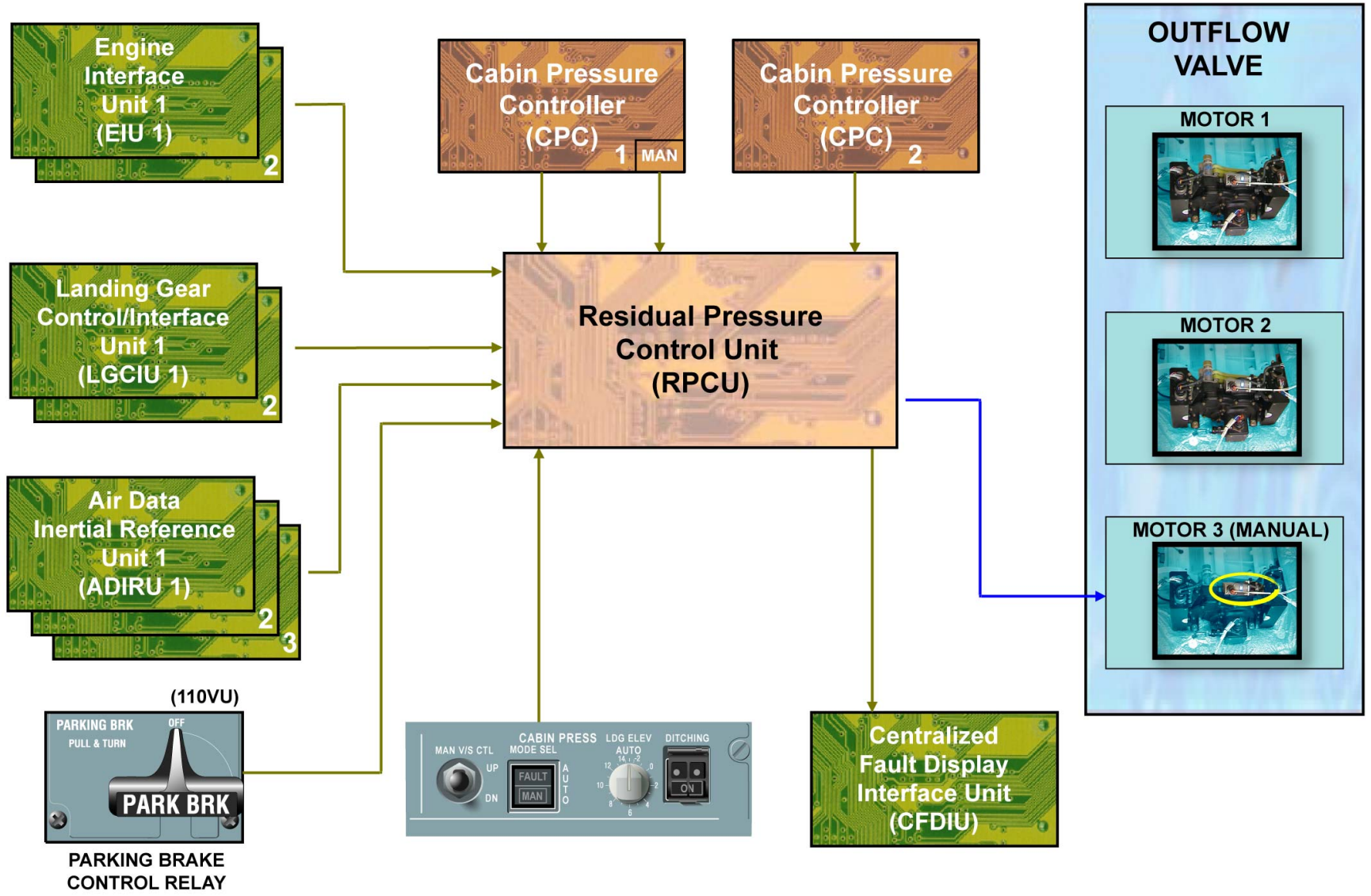


RPCU INTERFACES

SYSTEM CONTROL INTERFACES (3)

CABIN ALTITUDE INDICATION

AUTO MODE

The calculation of the cabin altitude in the AUTO mode is done differently in relation to the aircraft altitude:
- If the aircraft altitude is higher than 5000 ft above take-off or landing fields, the cabin altitude is calculated to the standard atmosphere.
- If the aircraft altitude is lower than 5000 ft above take-off or landing fields, the cabin altitude is calculated to the true altitude above sea level with the barometric correction from the Air Data Inertial Reference System (ADIRS).

MANUAL MODE

The calculation of the cabin altitude in the MANual mode is done in the Display Management Computer (DMC) to standard atmosphere.
The Cabin Pressure Control System (CPCS) manual backup circuit supplies a cabin pressure value to the SDAC.
Thus, there can be a small difference in the cabin altitude values between the AUTO and MAN modes if the aircraft altitude is higher than 5000 ft above take-off or landing fields. There can be a difference between the cabin altitude values due to the barometric conditions (weather) if the aircraft altitude is lower than 5000 ft above take-off or landing fields.

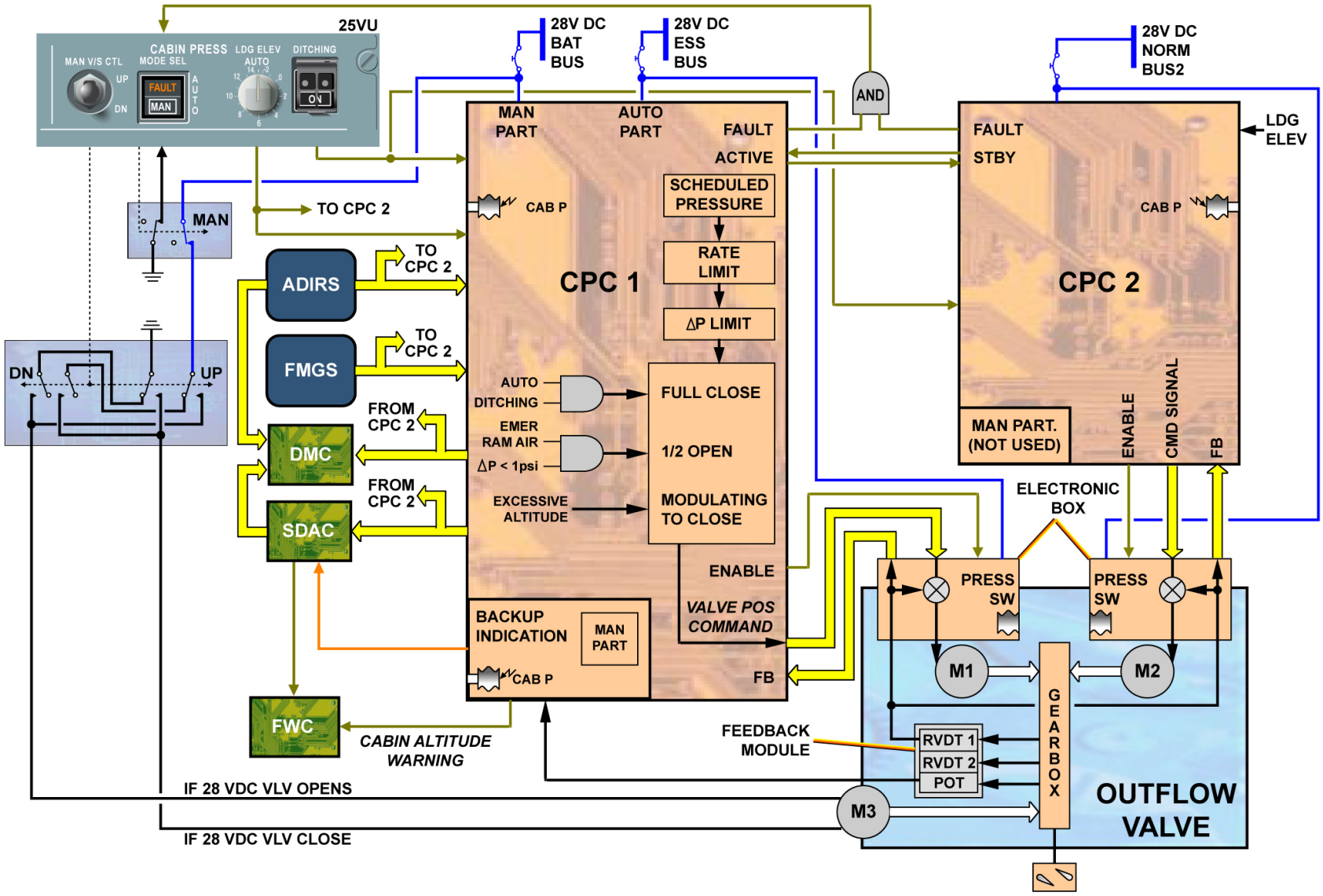
PRESSURIZATION CONTROL SYSTEM

AUTOMATIC OPERATION

The system has two identical, independent, automatic systems.
Each system has a CPC, which controls the pressure through a flap-type outflow valve.
In the automatic operation, the CPCs use the data from the Flight Management and Guidance System (FMGS) and the ADIRS.
The active CPC uses the auto-motor to control the outflow valve to the requested position. It also supplies data for indication on the Electronic Instrumentation System (EIS). Only one CPC operates the system at a time, while the other system is in hot standby.
The change of control from one CPC to the other is fully automatic after each flight, on landing.
The CPCs will also change in flight if there is a failure of one of the control systems.

MANUAL OPERATION

The MAN V/S toggle switch controls the manual motor of the outflow valve when the MAN SEL switch is selected to MAN.
These controls are installed in the cockpit, on the CABIN PRESS overhead panel.
In manual mode, the backup channel of the CPC in position no. 1 is used. It has a pressure sensor to start the excess cabin altitude warning and pressure outputs for the indication on the EIS.
If the MAN Part of CPC1 is active, the data for indication on EIS come from the ADIRUs and the SDAC.



CABIN ALTITUDE INDICATION & PRESSURIZATION CONTROL SYSTEM

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SYSTEM MONITORING INTERFACES (3)

FWC

In case of excessive cabin altitude, the active controller sends a discrete signal to both Flight Warning Computers (FWCs) for level 3 warnings. This warning is generated if cabin altitude exceeds 9550ft.

NOTE: Note: Each manual part is a separate, electrically supplied part.

SDAC

Both controllers send ARINC and discrete signals to the System Data Acquisition Concentrator (SDAC). When the system is in automatic mode, ARINC and discrete signals are used for monitoring and warning indications. In manual mode, 3 analog signals are provided from the manual part of CPC1 only.

CFDIU

Both controllers send BITE data to the Centralized Fault Display Interface Unit (CFDIU) via ARINC buses. This data is sent continuously or on request. The signal is a BITE data, used for Centralized Fault Display System (CFDS) monitoring.

CIDS

In case of excessive cabin altitude, the pressure controllers send a discrete signal to the Cabin Intercommunication Data System (CIDS). The cabin altitude exceeding 11300 ft signal is used for passenger signs.

CABIN PRESS PANEL

In case of failure of both automatic systems, the controllers send a discrete signal to the pressure panel for FAULT light illumination.

CABIN PRESS PANEL/SDAC

A manual mode selection signal is sent from the pressure panel to both SDACs. The MANual MODE SEL signal is used for ECAM display.

SAFETY VALVES/SDAC

The safety valve position signals are sent to both SDAC. The safety valve position signal is used for ECAM display.

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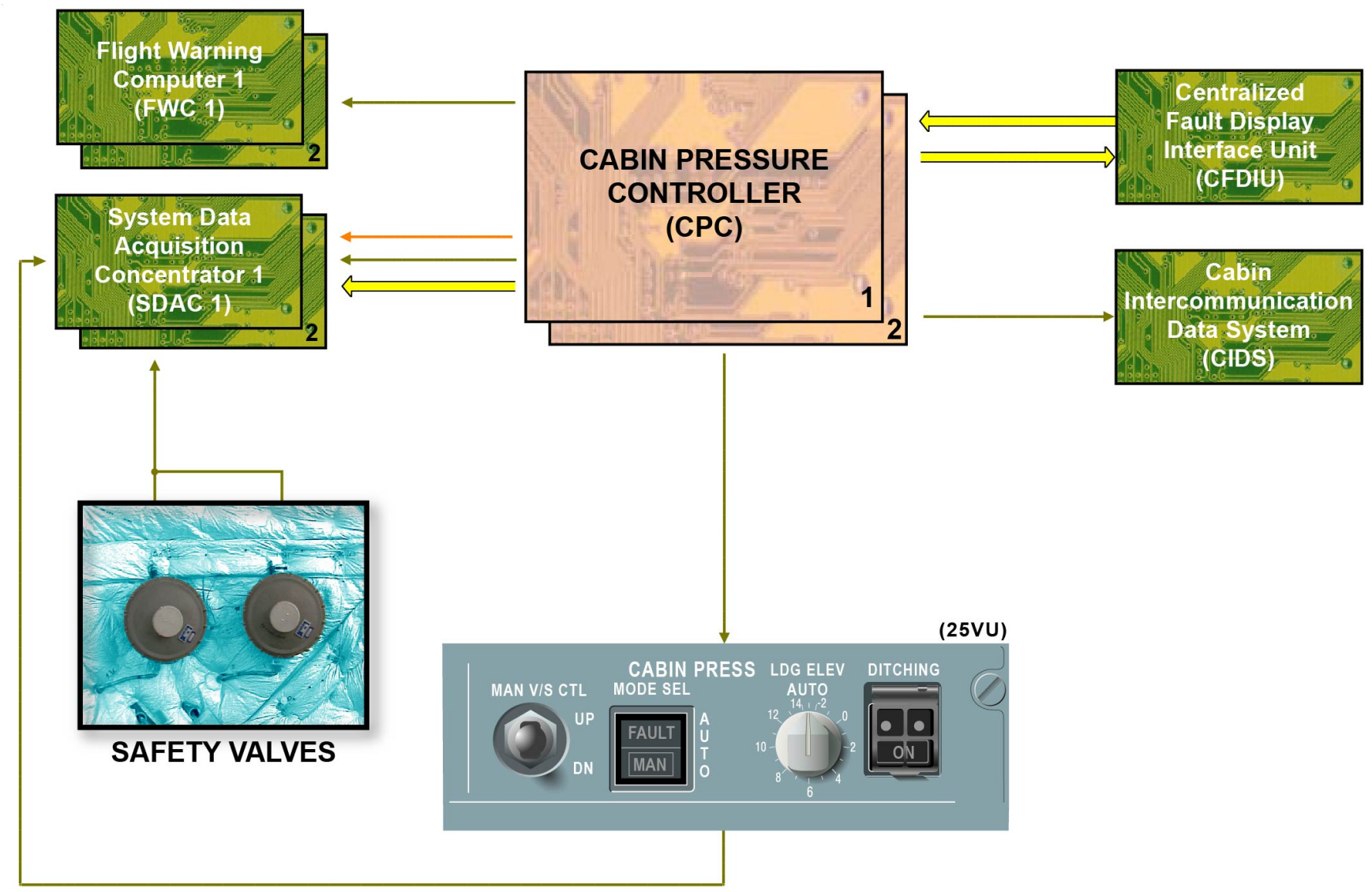

FWC ... SAFETY VALVES/SDAC

SYSTEM DESIGN PRESENTATION (2)

AVIONICS

The avionics ventilation system ensures a proper ventilation of the electrical equipment. Air is taken from different sources depending on the A/C configuration and ambient conditions. Ventilation air is blown to the equipment by a blower fan and extracted by an extraction fan. The cockpit temperature sensor for the temperature control system is connected to the extraction part of the avionics ventilation.

LAVatories and galleys

The lavatory (LAV) and galleys (GALY) ventilation system is used to remove unpleasant odors before they enter the cabin. Ventilation air is supplied from cabin distribution ducts and discharged overboard via the outflow valve by an extraction fan. The FWD and AFT cabin zones temperature sensors are connected to the lavatory and galley extraction system.

CARGO

The FWD and aft cargo compartments are ventilated by cabin ambient air coming from the cabin zones through openings in the cabin floor behind the sidewall panels. The FWD cargo compartment is ventilated by means of an extraction fan or by differential pressure. The aft cargo compartment is ventilated by means of an extraction fan only.

NOTE: Note: The ventilation system is optional and independent for each compartment.

CONTrollers

The Avionics Equipment Ventilation Computer (AEVC) ensures control and monitoring of the AVNCS ventilation system. The cargo ventilation controller (CONT) controls and monitors the isolation valves and the extraction fan of the cargo ventilation system.

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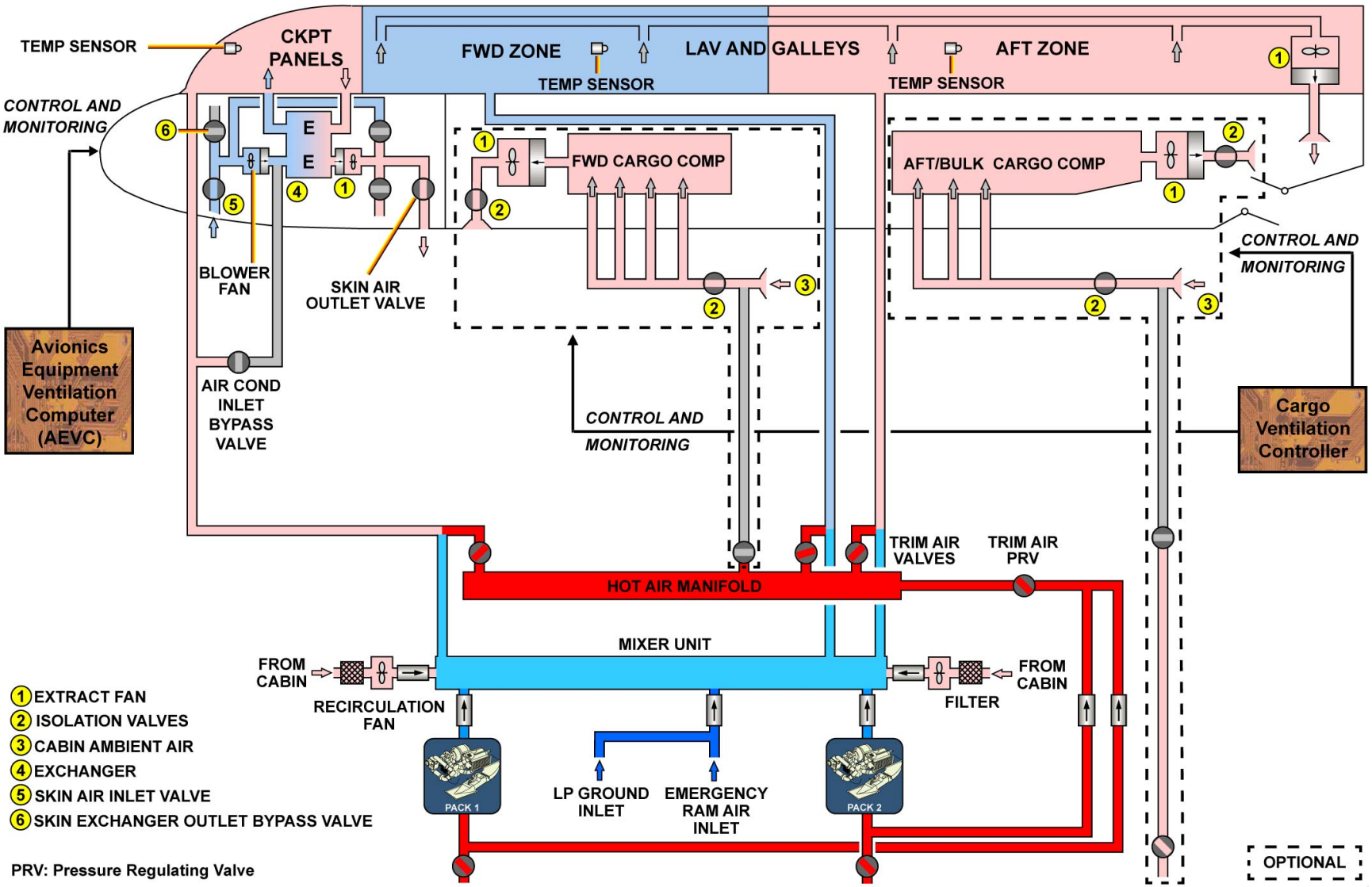


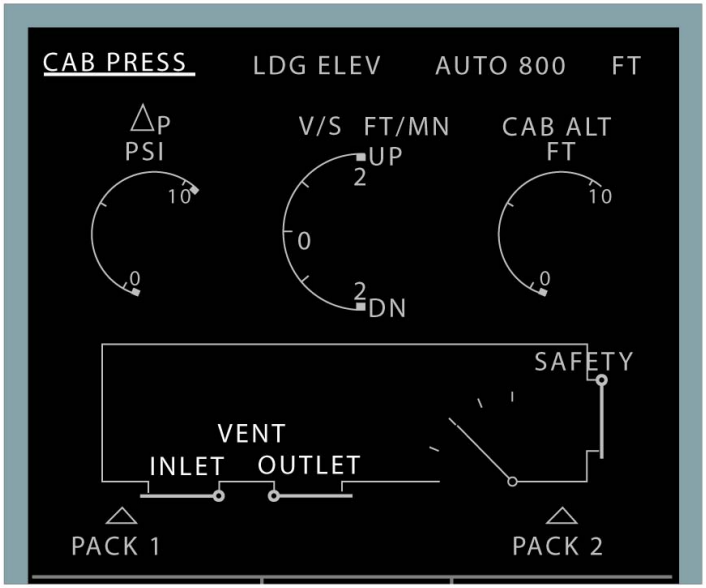
AVIONICS ... CONTROLLERS

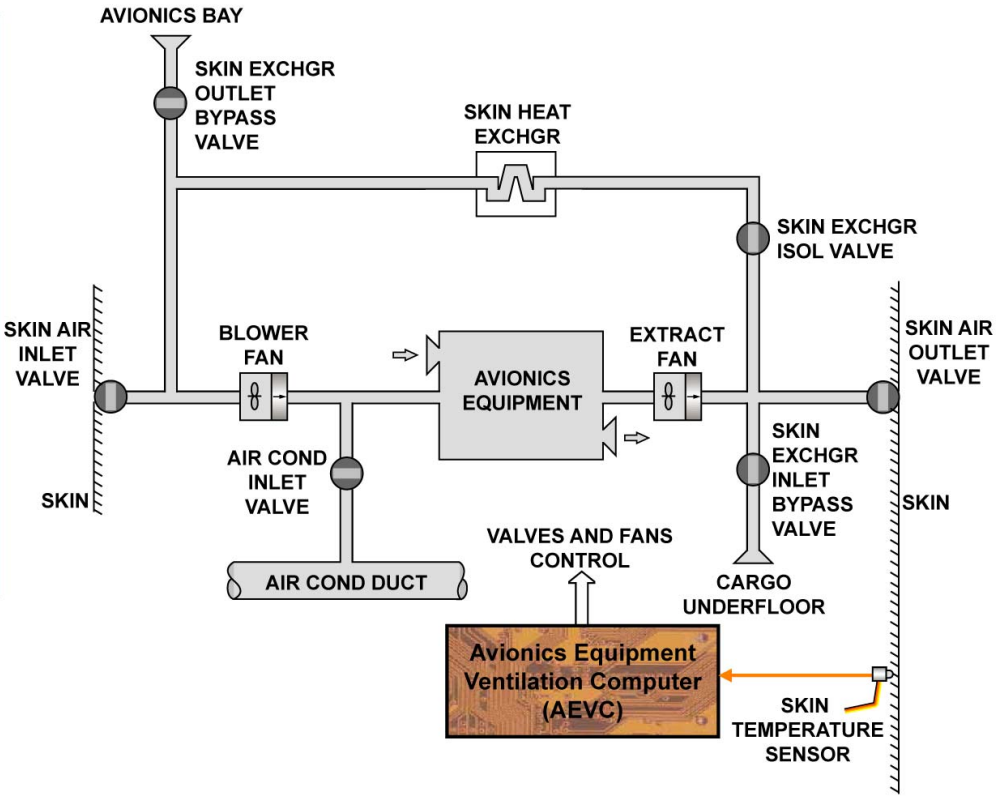
SYSTEM DESCRIPTION AND OPERATION (3)

GENERAL

The system is automatically controlled by the Avionics Equipment Ventilation Computer (AEVC) and no crew action is required. The AEVC will change the system configuration depending on whether the A/C is on ground or in flight and on A/C skin temperature.

NOTE: The BLOWER and EXTRACT P/Bs must be in AUTO position.





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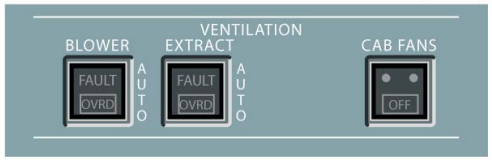

GENERAL

SYSTEM DESCRIPTION AND OPERATION (3)

OPEN CIRCUIT CONFIGURATION

In open circuit configuration, ambient air drawn through the skin air inlet valve by the blower fan, is blown into the system. The air, after cooling the avionics equipment, is drawn by the extraction fan directly overboard. The open circuit configuration allows avionics equipment to be cooled with ambient air under certain conditions. (On ground and skin temperature above 12°C (53,6°F) increasing, or above 9°C (48,2°F) decreasing).

NOTE: The skin air inlet and outlet valves are fully open.

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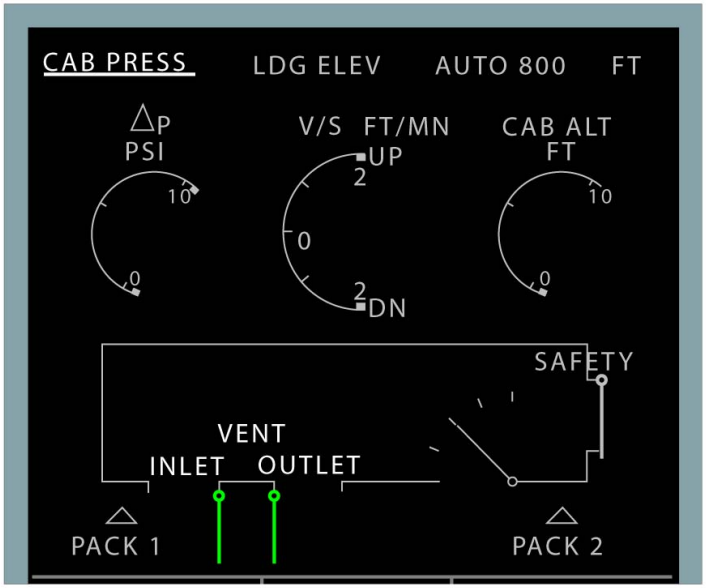

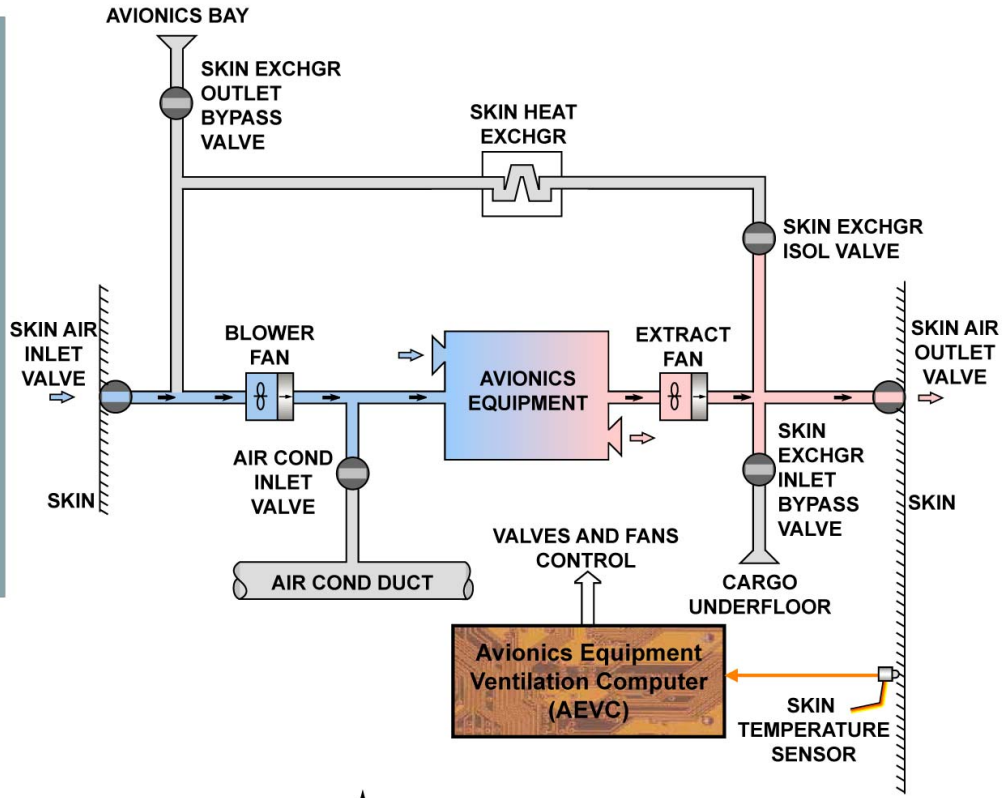

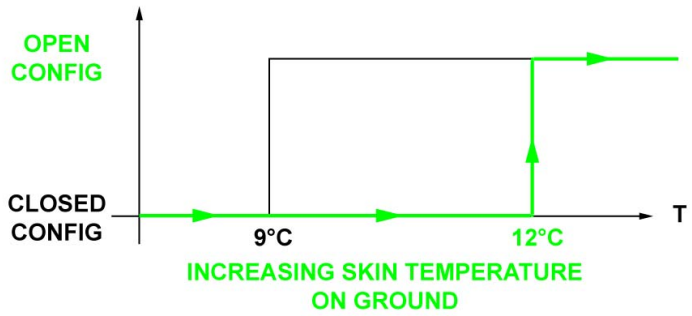

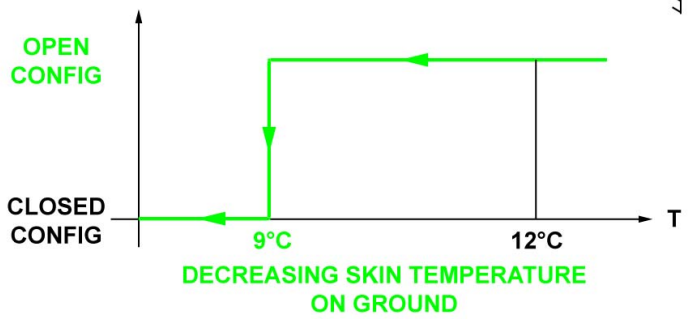

OPEN CIRCUIT CONFIGURATION

SYSTEM DESCRIPTION AND OPERATION (3)

CLOSED CIRCUIT CONFIGURATION

In closed circuit configuration, the extracted avionics equipment air goes through the skin exchanger isolation valve into the skin heat exchanger to be cooled. Then this air is blown into the avionics equipment again. The skin exchanger inlet bypass valve is controlled by the AEVC in accordance to the system configuration to discharge the air under the FWD cargo compartment. The skin exchanger outlet bypass valve opens in order to decrease the noise level in the avionics bay.

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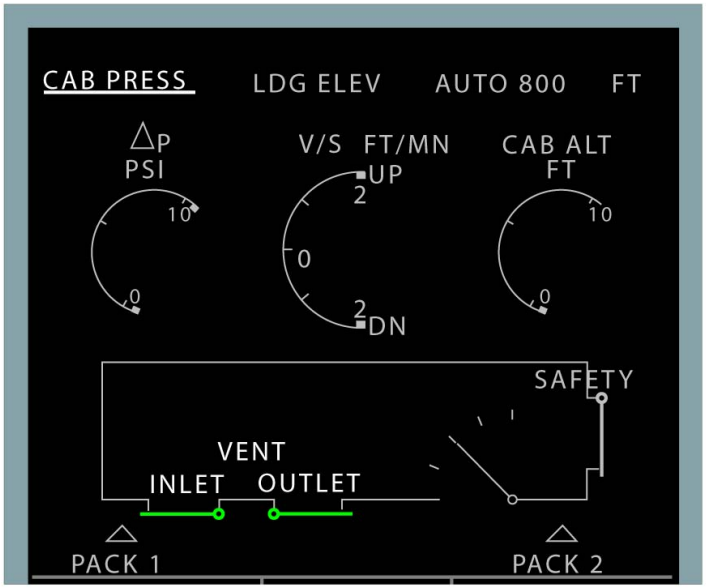
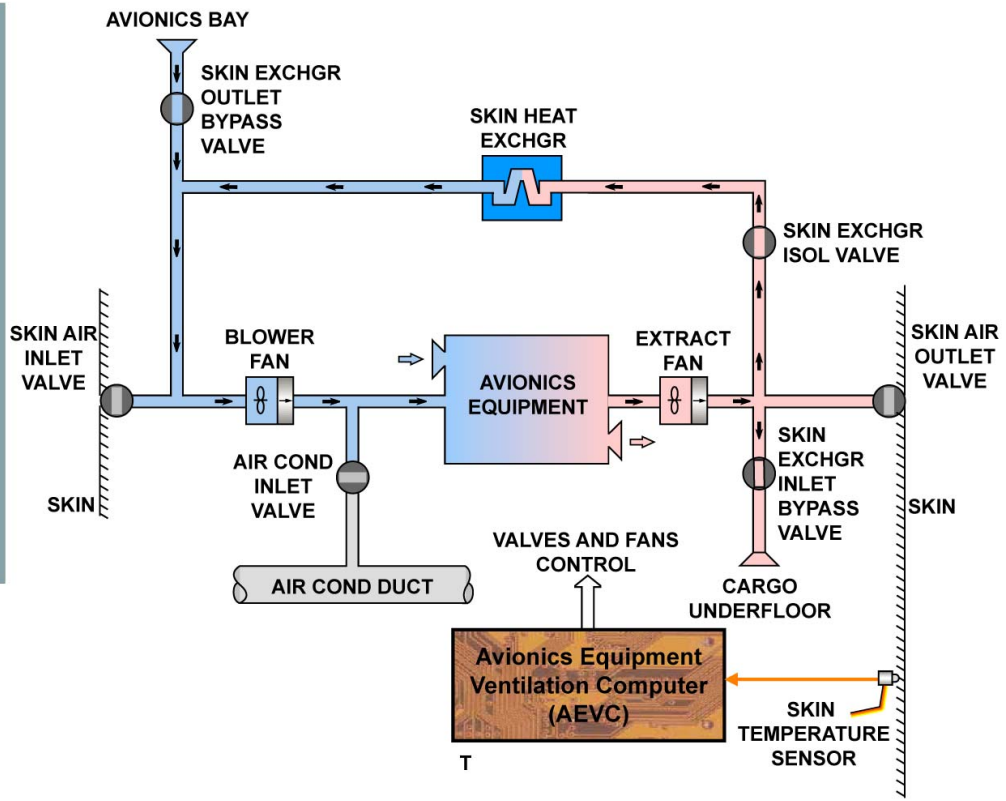
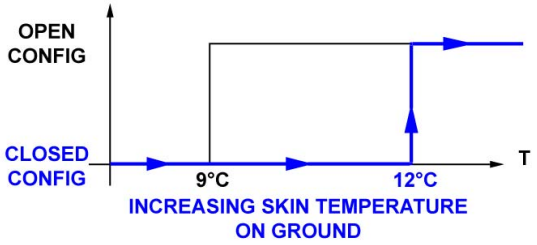
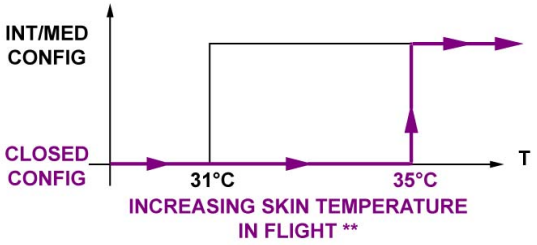
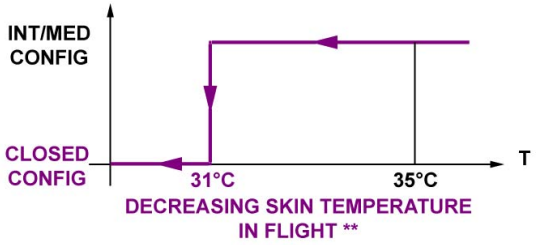










* : VALVE CONTROLLED IN ACCORDANCE WITH SYSTEM CONFIGURATION

** : "IN FLIGHT" MEANS A/C AIRBORNE OR A/C ON GROUND WITH TAKE-OFF POWER SELECTED

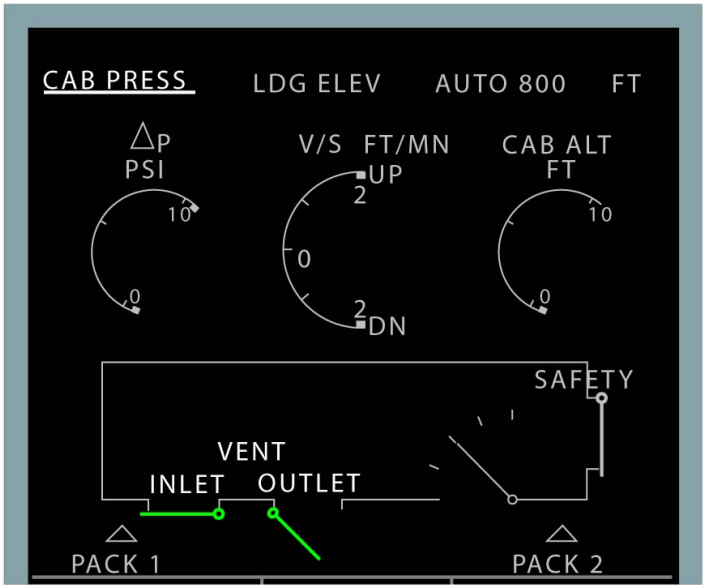
CLOSED CIRCUIT CONFIGURATION

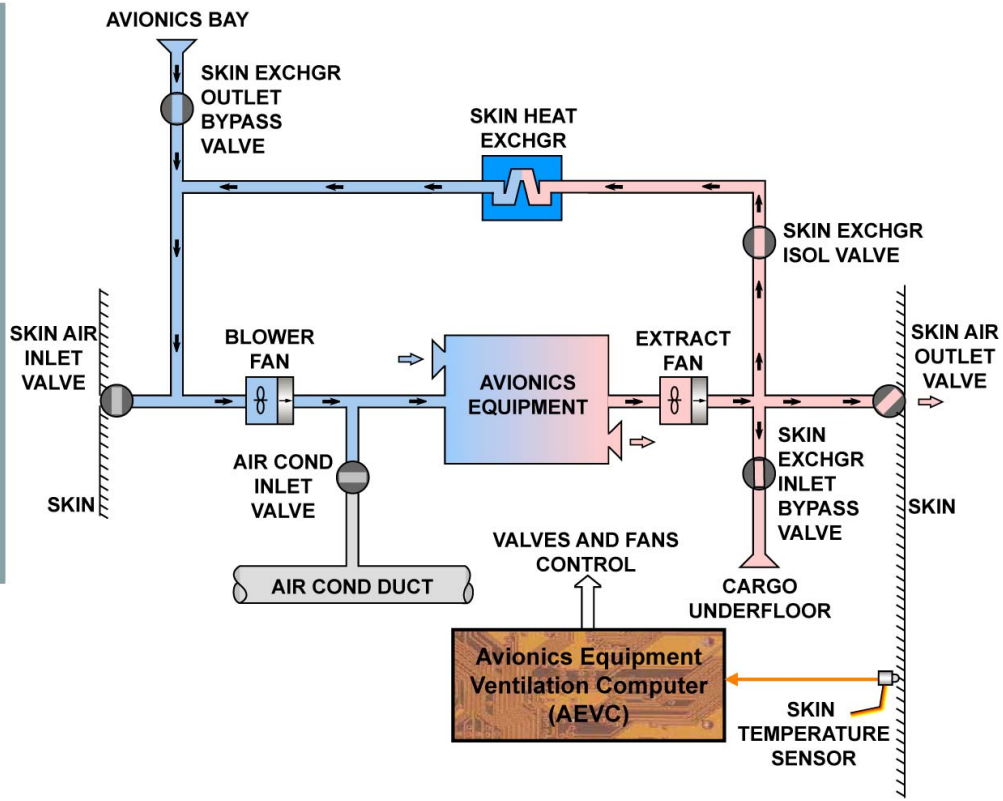
SYSTEM DESCRIPTION AND OPERATION (3)

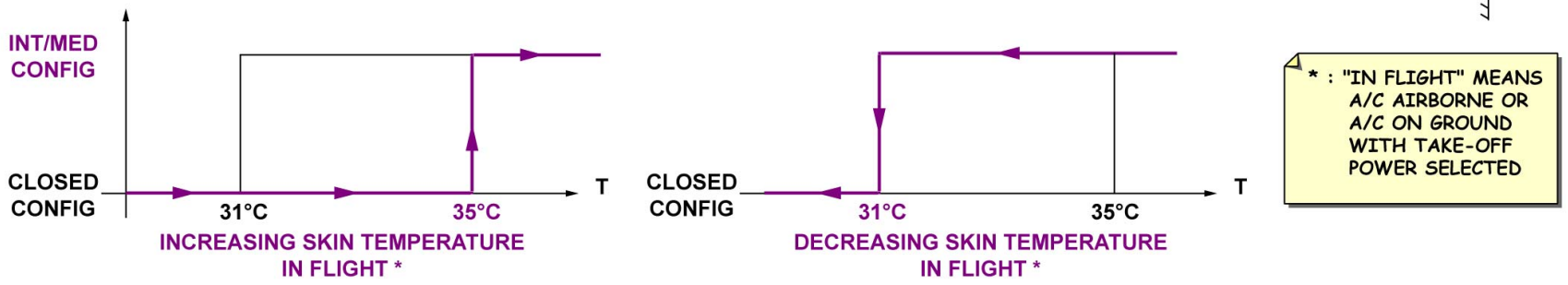
PARTIALLY OPEN CIRCUIT CONFIGURATION

In partially open circuit configuration, the system is almost like in closed configuration, part of the extracted air is expelled overboard.

NOTE: The skin air outlet valve is an electrically operated single flap valve with a smaller flap built into it. This smaller flap is opened in flight or on ground with takeoff power selected, when the skin temperature is above 35°C (95,0°F). It returns to the closed position when the skin temperature decreases below 31°C (87,8°F).







PARTIALLY OPEN CIRCUIT CONFIGURATION

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SYSTEM INTERFACES (3)

LGCIU

Landing Gear Control and Interface Units (LGCIUs) 1 and 2 send a signal to the Avionics Equipment Ventilation Computer (AEVC) for ventilation system control. The ground/flight signal is used for system control.

EIU

Engine Interface Units (EIUs) 1 and 2 send the takeoff thrust signal to the AEVC for ventilation system control. The thrust lever set to takeoff and a N2 above idle signal is used for system control.

CFDIU

The AEVC sends BITE data to the Centralized Fault Display Interface Unit (CFDIU) via an ARINC bus. Test of the system is done by sending a test demand discrete signal to the AEVC. The signals BITE data via an ARINC bus and the MCDU test demand via a discrete are used for avionics equipment ventilation system monitoring.

CONTROLLER AEVC/SDAC

The AEVC monitors the skin air valves position, the conditioned air inlet valve and the exchanger inlet bypass valve position. In case of valve position disagree or loss of power supply of the AEVC, the AEVC sends an avionics system fault signal to both SDACs. The avionics system fault signal is used for valve position disagree warning on ground or loss of power supply of the AEVC.

SKIN TEMPERATURE SENSOR

The skin temperature sensor signals the skin temperature to the computer for configuration control.

SKIN AIR VALVEs/SDAC

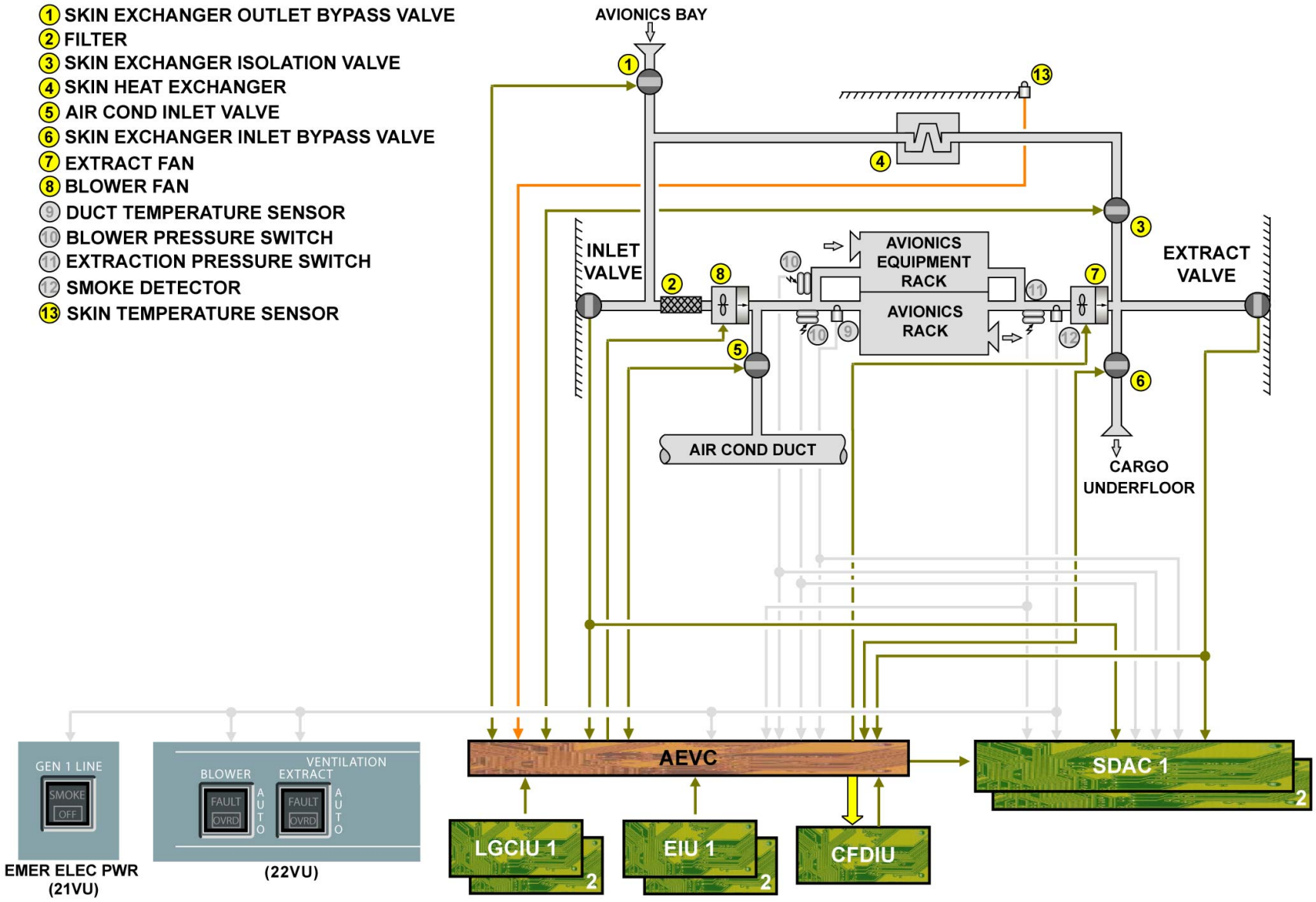
The skin air valves position signals are sent to both System Data Acquisition Concentrators (SDACs) for system display and for skin valve fault warning. The skin valve position feedback signal is used for system display and valve position disagree warning in flight.

MONITORING

Valves, sensors, fans and switches are monitored by the AEVC. Additionally failure status is displayed on the ECAM and control panels.

UGB13131 - U7ST0M0 - UM21F4000000001

1 SKIN EXCHANGER OUTLET BYPASS VALVE
2 FILTER
3 SKIN EXCHANGER ISOLATION VALVE
4 SKIN HEAT EXCHANGER
5 AIR COND INLET VALVE
6 SKIN EXCHANGER INLET BYPASS VALVE
7 EXTRACT FAN
8 BLOWER FAN
9 DUCT TEMPERATURE SENSOR
10 BLOWER PRESSURE SWITCH
11 EXTRACTION PRESSURE SWITCH
12 SMOKE DETECTOR
13 SKIN TEMPERATURE SENSOR



LGCIU ... MONITORING

SYSTEM INTERFACES (3)

BLOWING PRESSURE SWITCHES AND DUCT TEMPERATURE SENSOR

The blowing pressure switches and the duct temperature sensor signal a low flow and a high duct temperature to the controller to both SDACs and to the BLOWER P/B. On the ground, the ADIRU and AVNCS VENT lights come on amber on the external power receptacle accompanied by the horn activation. LP Delta P = 0.025 psi (1.73 hPa) signal or high duct temperature 62°C (144°F) signal, are used for fault and ventilation ground warnings located on the external power receptacle.

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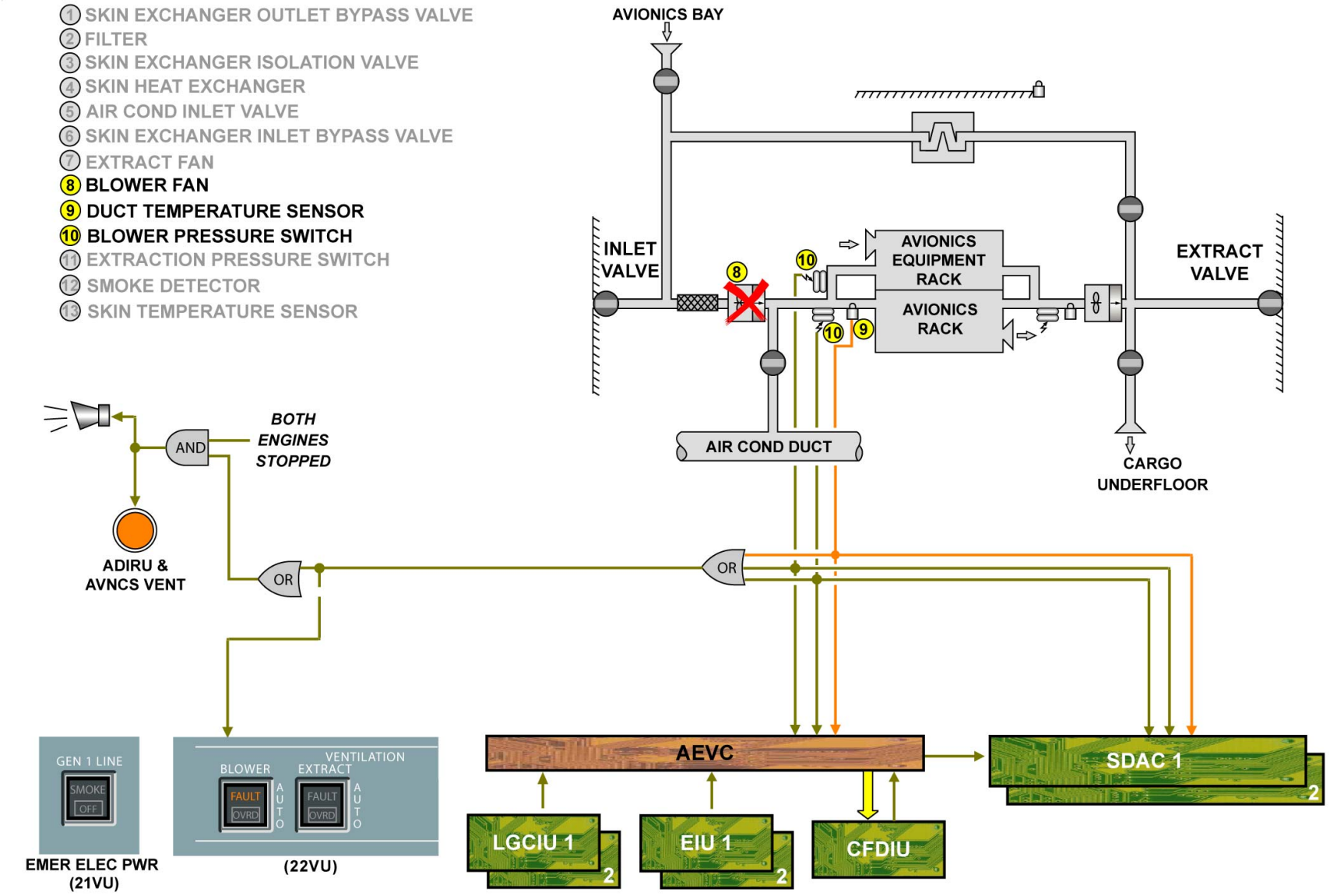


BLOWING PRESSURE SWITCHES AND DUCT TEMPERATURE SENSOR

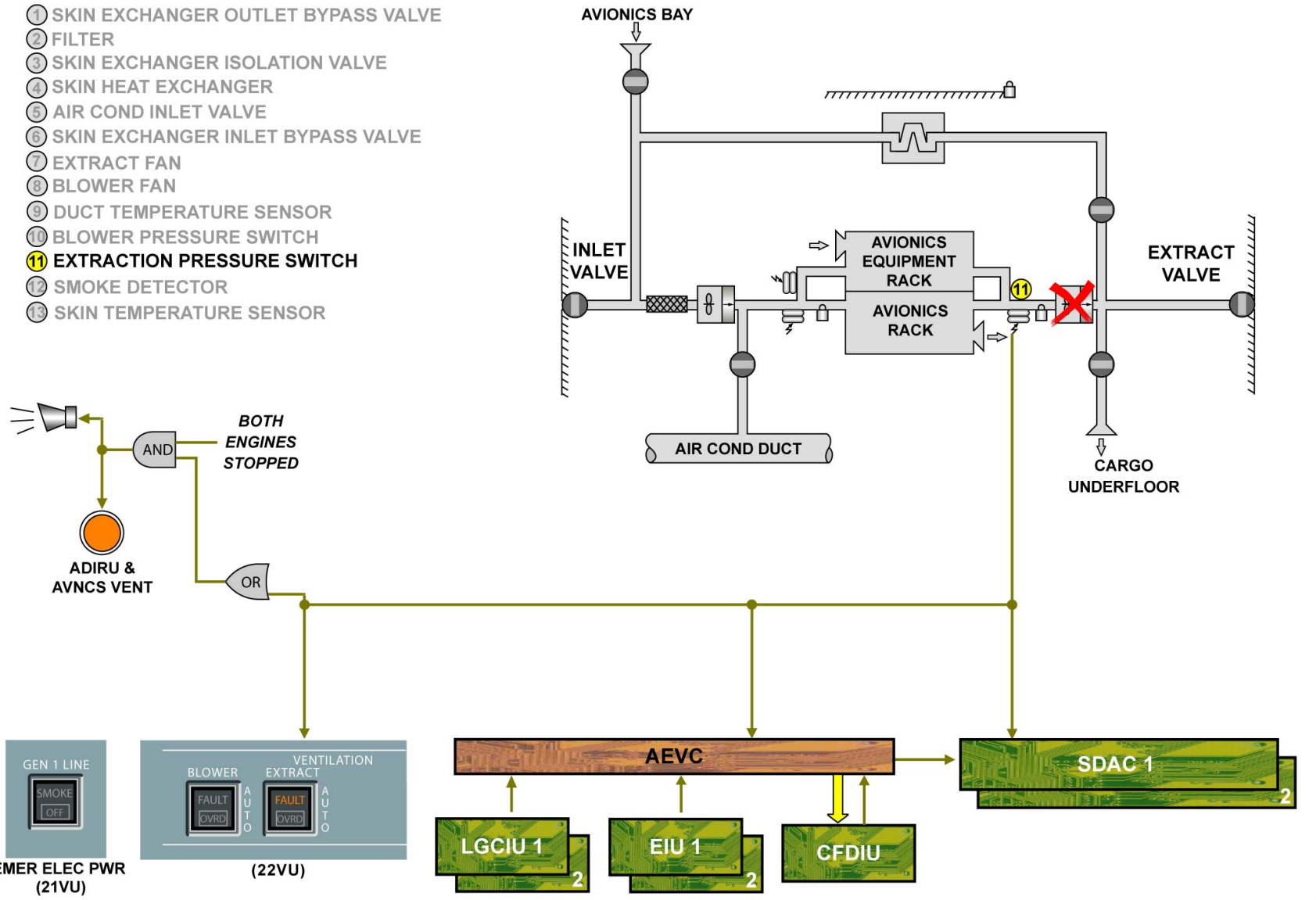
UGB13131 - U7ST0M0 - UM21F4000000001

SYSTEM INTERFACES (3)

EXTRACT PRESSURE SWITCH

The extract pressure switch signals a low flow to the controller to both SDACs and to the EXTRACT P/B. On the ground, the ADIRU and AVNCS VENT lights come on amber on the external power receptacle accompanied by the horn activation. The extract LP is used for fault and ventilation ground warnings located on the external power receptacle.

1 SKIN EXCHANGER OUTLET BYPASS VALVE
2 FILTER
3 SKIN EXCHANGER ISOLATION VALVE
4 SKIN HEAT EXCHANGER
5 AIR COND INLET VALVE
6 SKIN EXCHANGER INLET BYPASS VALVE
7 EXTRACT FAN
8 BLOWER FAN
9 DUCT TEMPERATURE SENSOR
10 BLOWER PRESSURE SWITCH
11 EXTRACTION PRESSURE SWITCH
12 SMOKE DETECTOR
13 SKIN TEMPERATURE SENSOR



EXTRACT PRESSURE SWITCH

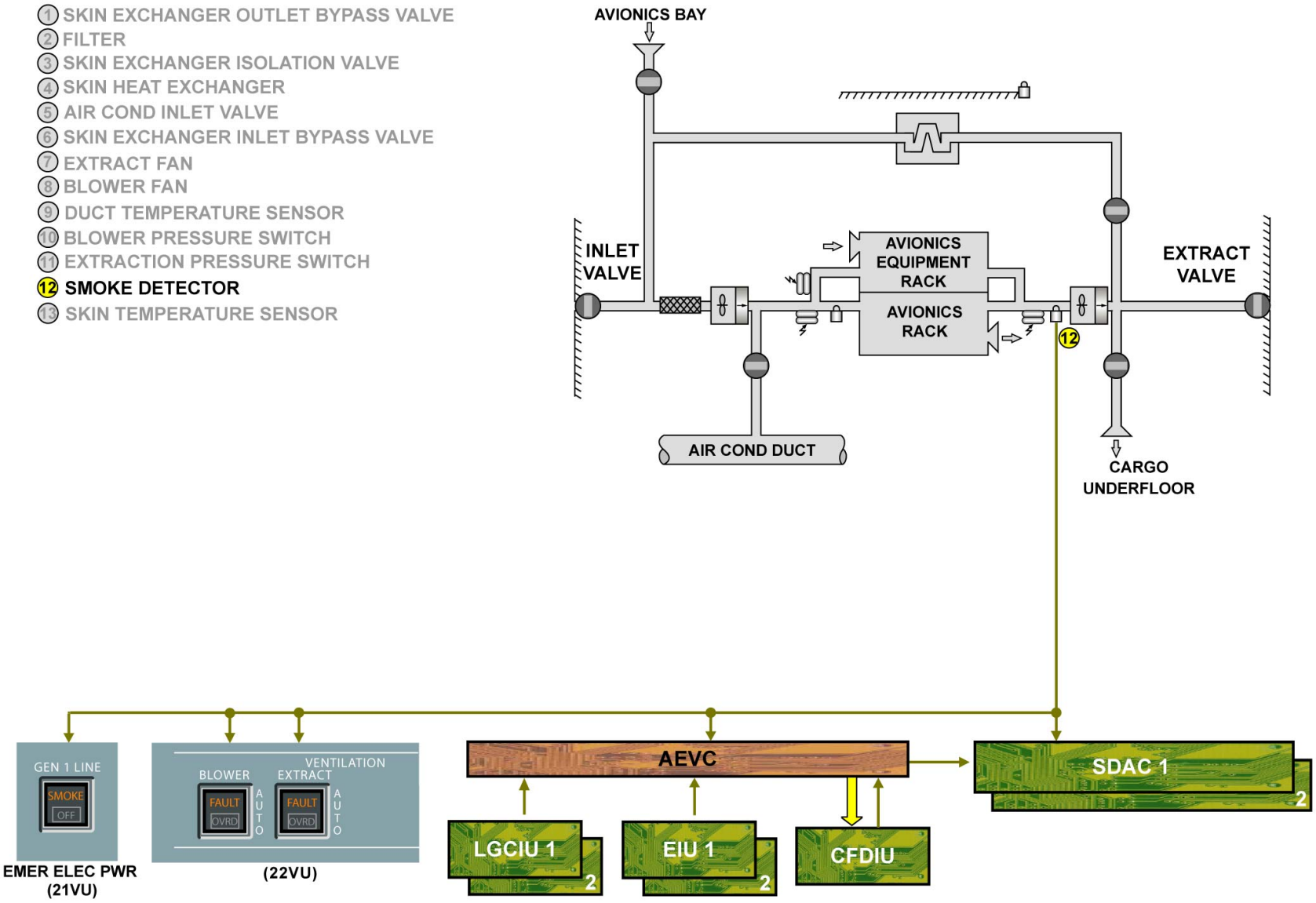
SYSTEM INTERFACES (3)

SMOKE DETECTOR

The smoke detector signals smoke to the controller, to both VENTILATION P/Bs and to the GEN 1 LINE P/B. The smoke detected is used for smoke warning.

UGB13131 - U7ST0M0 - UM21F4000000001

1 SKIN EXCHANGER OUTLET BYPASS VALVE
2 FILTER
3 SKIN EXCHANGER ISOLATION VALVE
4 SKIN HEAT EXCHANGER
5 AIR COND INLET VALVE
6 SKIN EXCHANGER INLET BYPASS VALVE
7 EXTRACT FAN
8 BLOWER FAN
9 DUCT TEMPERATURE SENSOR
10 BLOWER PRESSURE SWITCH
11 EXTRACTION PRESSURE SWITCH
12 SMOKE DETECTOR
13 SKIN TEMPERATURE SENSOR



SMOKE DETECTOR

UGB13131 - U7ST0M0 - UM21F4000000001

SYSTEM CONTROLS PRESENTATION (3)

SYSTEM INTRODUCTION

Air from the main cabin is drawn down into the cargo compartment by the extract fan or by differential pressure in flight. After circulating through the compartment, the air is discharged overboard. The operation of the two isolation valves and the extract fan is controlled automatically by the cargo Ventilation Controller (VC). One VC is able to control either or both compartments.
For the heating of the cargo compartment, the pilots select the desired compartment temp and hot bleed air is mixed with the air coming from the main cabin to increase the temperature if necessary. The supply of hot air is controlled by the Cargo Heating Controller.
Note that there is NO direct air conditioning supply to the cargo compartments. The pilots cannot add "cold" air to the compartments.
On the cockpit overhead panel, the CARGO HEAT panel contains the controls associated with cargo ventilation and heating. Again, based on the customer options, several variations may be found: ventilation in either one compartment or both, or ventilation and heating in one compartment or both. For each ventilated cargo compartment there is an ISOLATION VALVE P/B switch that controls the isolation valves. In the auto position the cargo VC will automatically open and close the isolation valves.

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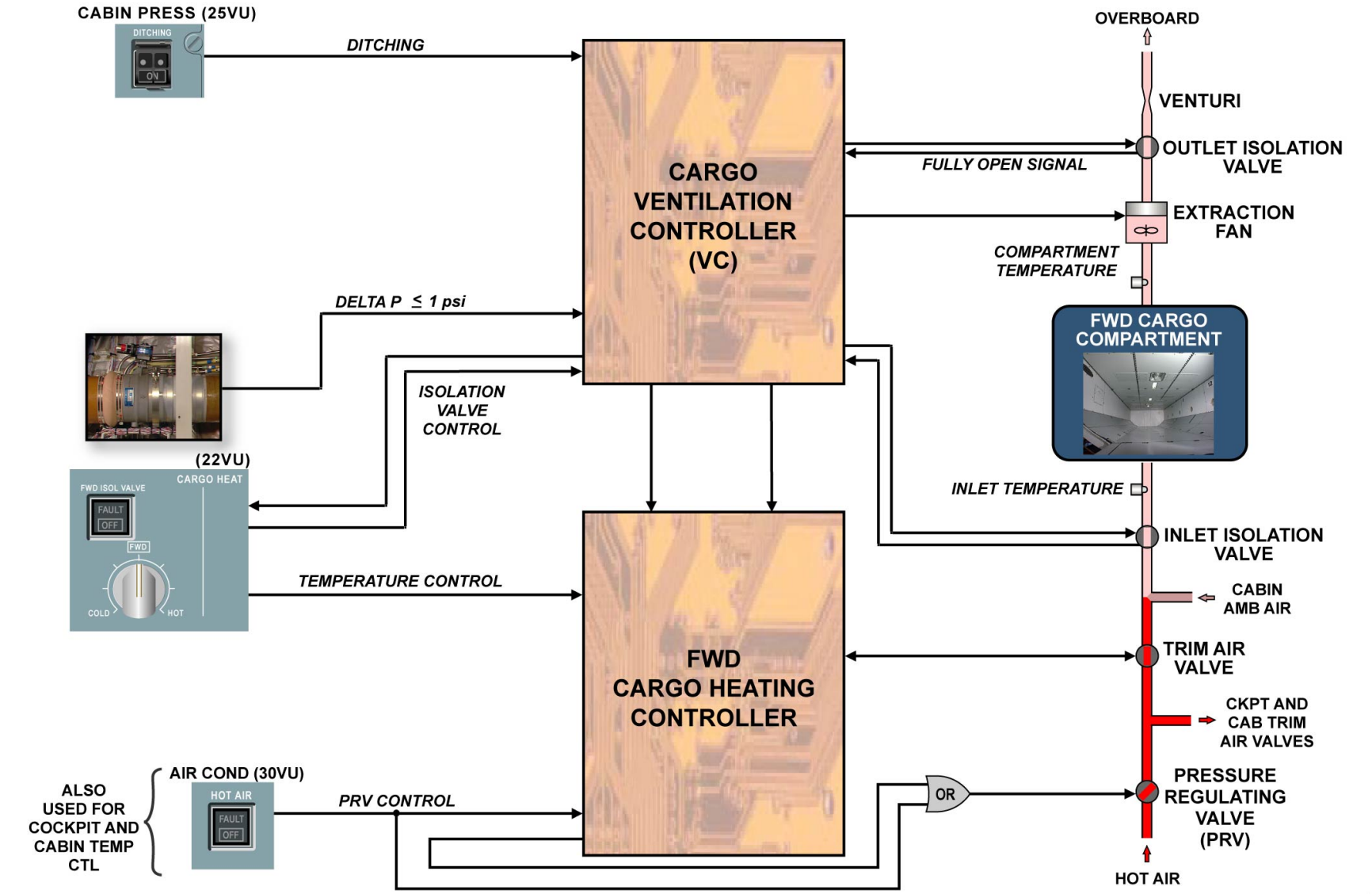

SYSTEM INTRODUCTION

SYSTEM CONTROLS PRESENTATION (3)

FWD ISOL VALVE P/B

The FWD ISOLation VALVE P/B controls the isolation valves and the extraction fan through the ventilation controller. When it is pressed in, the cargo ventilation controller will start the extraction fan, if both valves are fully open and Differential Pressure (DELTA P) is no more than 1psi. When it is set to OFF or if smoke is detected or the DITCHING P/BSW is ON, the isolation valves are closed and the extraction fan stops.

TEMPERATURE SELECTOR

The temperature rotary selector gives the desired temperature to the heating controller, which controls the trim air valve to add hot air to cabin ambient air, if necessary. The selector temperature range is between 5ºC (41ºF) and 26ºC (79ºF), with 16ºC (60ºF) at the 12 o'clock position.

HOT AIR P/B

The HOT AIR P/BSW is used to control the cockpit and cabin hot air Pressure Regulating Valve (PRV). When it is set to OFF, the valve is closed.

NOTE: Note: In case of duct temperature above 88ºC (190ºF), the heating controller controls the HOT AIR PRV to close.

CARGO SMOKE

In case of cargo smoke detected, the cargo ventilation controller will automatically close the related isolation valves.
For each heated compartment, the temperature selectors signal the associated Cargo Heating Controller to move the trim air valves to adjust the temperature of the air entering the compartment.

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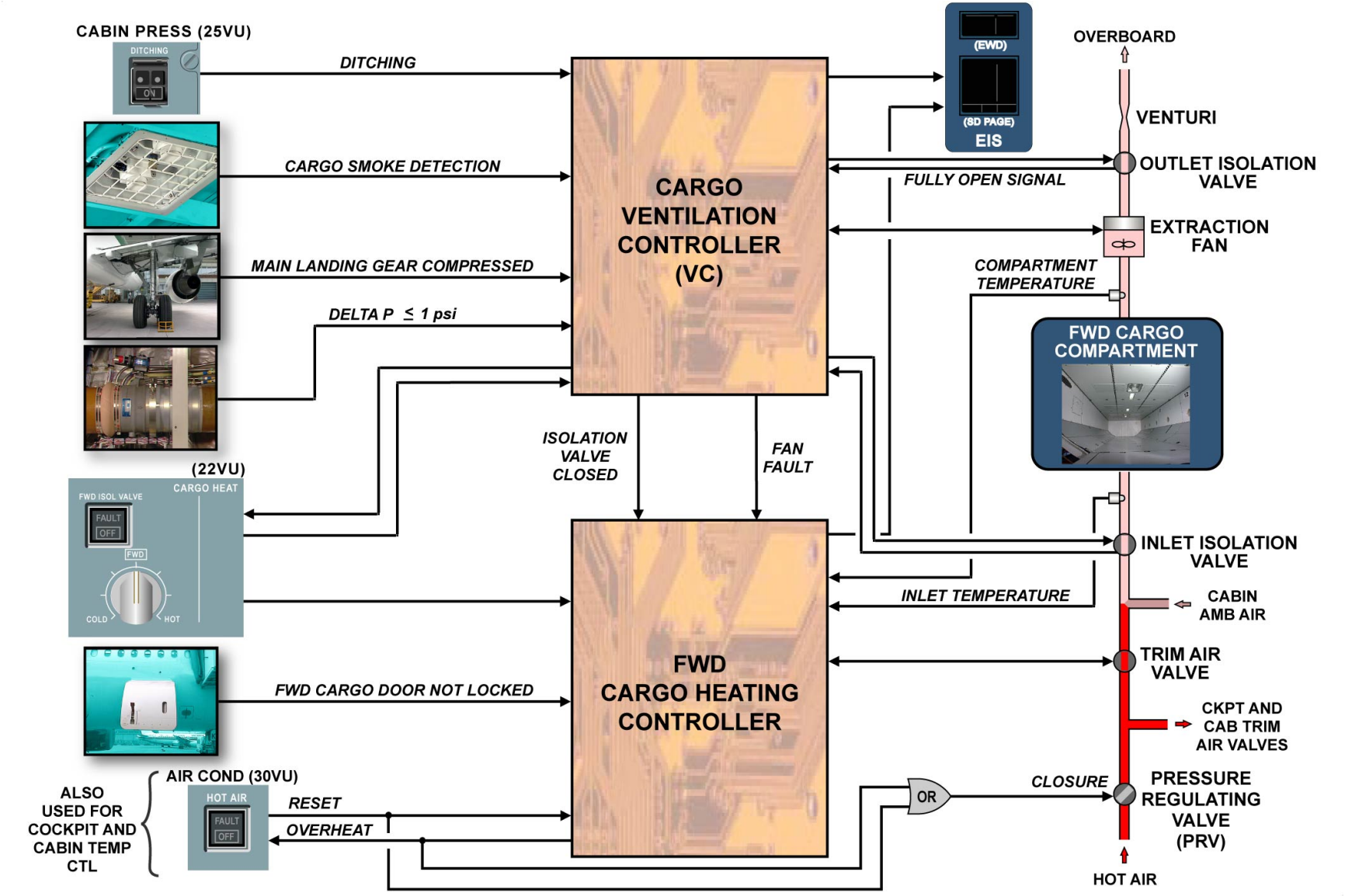

FWD ISOL VALVE P/B ... CARGO SMOKE

SYSTEM CONTROLS PRESENTATION (3)

SYSTEM INTRODUCTION

Air from the main cabin is drawn down into the cargo compartment by the extract fan or by differential pressure in flight. After circulating through the compartment, the air is discharged overboard.
The operation of the two isolation valves and the extract fan is controlled automatically by the cargo Ventilation Controller (VC). One VC is able to control either or both compartments.
For the heating of the cargo compartment, the pilots select the desired compartment temp and hot bleed air is mixed with the air coming from the main cabin to increase the temperature if necessary. The supply of hot air is controlled by the Cargo Heating Controller. Each heated compartment has a dedicated Cargo Heating Controller. Note that there is NO direct air conditioning supply to the cargo compartments. The pilots cannot add "cold" air to the compartments.
On the cockpit overhead panel, the CARGO HEAT panel contains the controls associated with cargo ventilation and heating. Again, based on the customer options, several variations may be found: ventilation in either one compartment or both, or ventilation and heating in one compartment or both.
For each ventilated cargo compartment there is an ISOLATION VALVE P/B switch that controls the isolation valves. In the auto position the cargo VC will automatically open and close the isolation valves.

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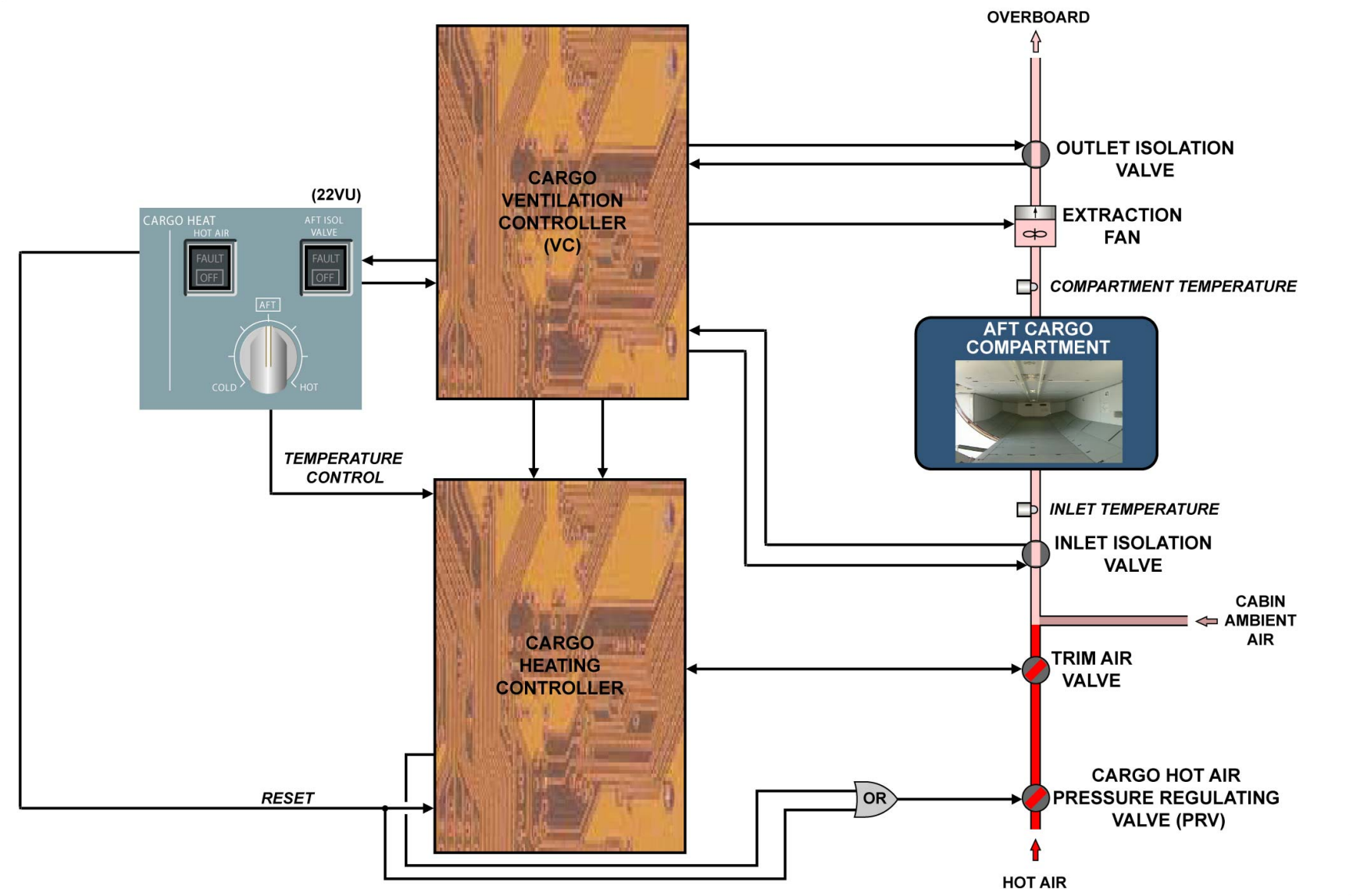


SYSTEM INTRODUCTION

SYSTEM CONTROLS PRESENTATION (3)

AFT ISOL VALVE P/B

The AFT ISOLation VALVE P/B controls the isolation valves and the extraction fan through the ventilation controller. When it is pressed, the cargo ventilation controller will start the extract fan, only if both isolation valves are fully open. When it is set to OFF or if smoke is detected, the isolation valves are closed and the extract fan stops.

TEMPERATURE SELECTOR

The temperature rotary selector gives the desired temperature to the heating controller, which controls the trim air valve to add hot air to cabin ambient air, if necessary. The selector temperature range is between 5°C (41°F) and 26°C (79°F) with 16°C (60°F) at the 12 o'clock position.

HOT AIR P/B

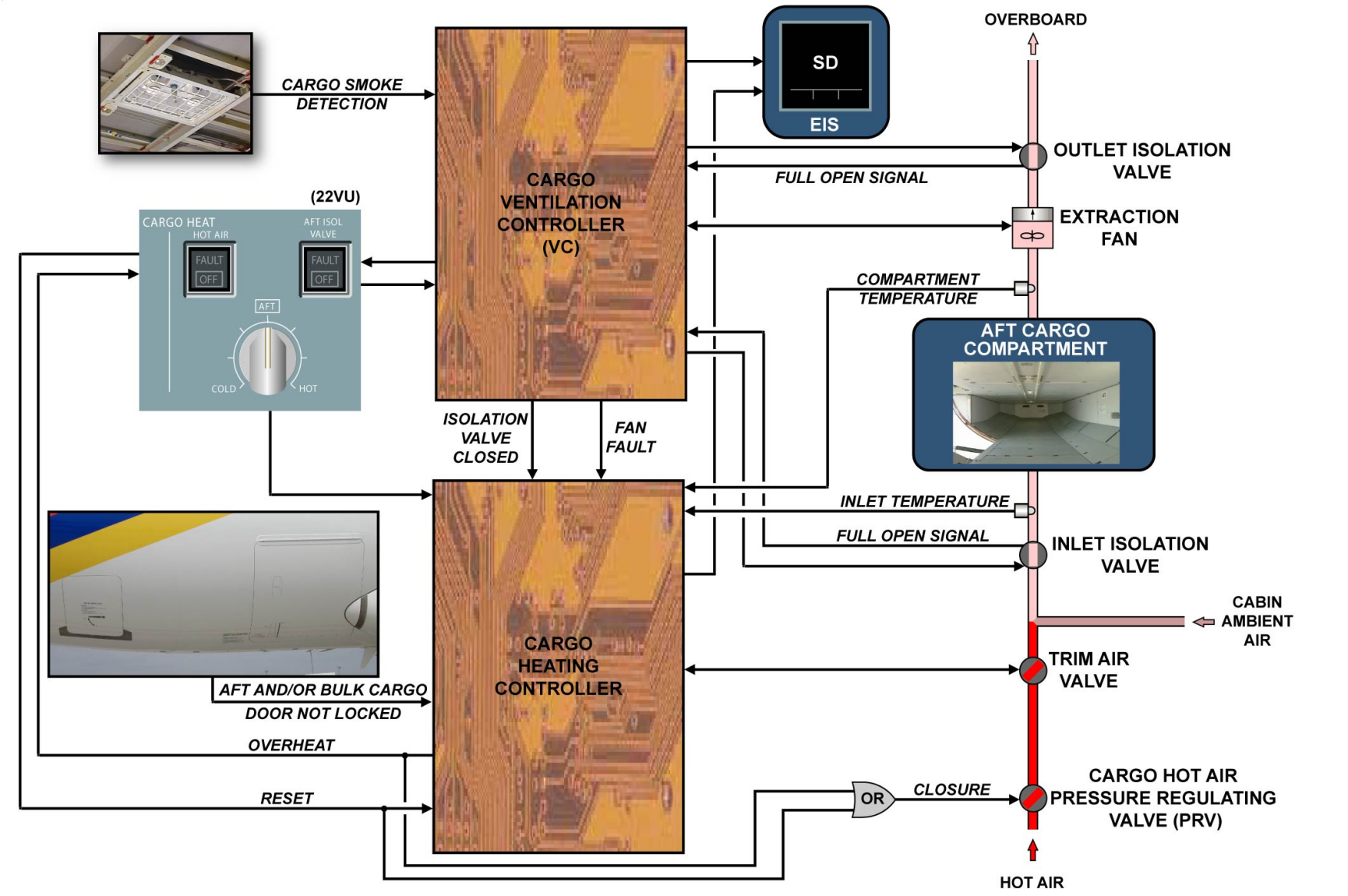
The HOT AIR P/BSW is used to control the cargo hot air Pressure Regulating Valve (PRV). When it is set to OFF, the valve is closed.
The task of such pressure-regulating valve is to reduce the bleed pressure to 4 psi above the cabin pressure. It acts as a shut-off valve.

NOTE: Note: In case of duct temperature above 88°C (190°F), the heating controller controls the cargo hot air PRV to close.

CARGO SMOKE

In case of cargo smoke detected, the cargo ventilation controller will automatically close the related isolation valves.
For each heated compartment, the temperature selectors signal the associated Cargo Heating Controller to move the trim air valves to adjust the temperature of the air entering the compartment.

UGB13131 - U7ST0M0 - UM21P600000001



AFT ISOL VALVE P/B ... CARGO SMOKE

AIR CONDITIONING SYSTEM LINE MAINTENANCE (2)

MEL/DEACTIVATION

Per the Minimum Equipment List (MEL), the following deactivation procedures may be performed to dispatch the aircraft with air conditioning and ventilation problems.

PACK FLOW CONTROL VALVE

The aircraft may be dispatched per MEL with the pack Flow Control Valve (FCV) failed. With the valve secured in the CLOSED position, single pack operations are limited to 31,500 / 35,400 / 37,000 ft. (depending on aircraft/engine combination).
Deactivation procedure:
- no pneumatic supply to the air conditioning system,
- remove access panel on belly fairing,
- set pack pushbutton switch OFF,
- remove the blanking cap from the position (A),
- make sure that the forked valve position indicator lever is at the CLOSED position,
- install the blanking cap between the forks of the valve position lever and on screwed boss (B),
- safety the blanking cap with corrosion-resistant steel lockwire 0.8mm.

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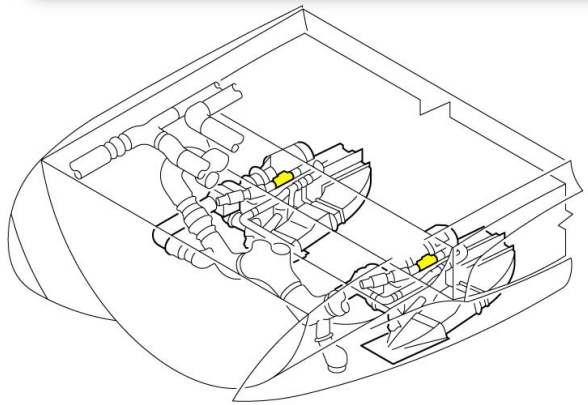
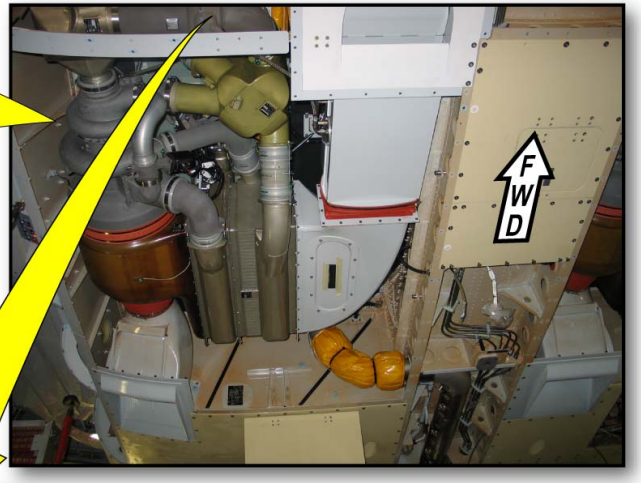
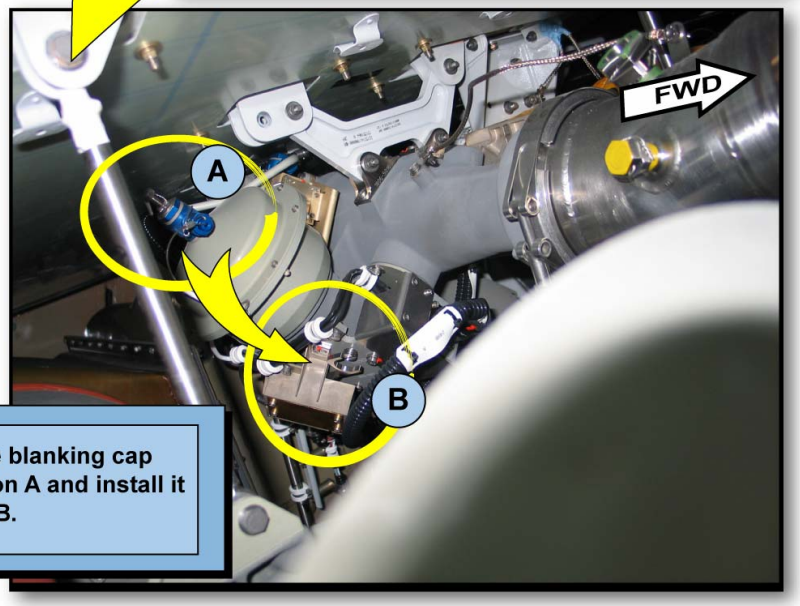
✓ Deactivation of the pack Flow Control Valve



PACK FLOW CONTROL VALVES LOCATION





✓ Remove the blanking cap from position A and install it in position B.

PACK FLOW CONTROL VALVE

MEL/DEACTIVATION - PACK FLOW CONTROL VALVE

AIR CONDITIONING SYSTEM LINE MAINTENANCE (2)

MEL/DEACTIVATION (continued)

AVIONICS VENTILATION SKIN AIR OUTLET VALVE

In case of failure, the Skin Air Outlet Valve may be deactivated in the PARTIAL-OPEN position for dispatch per the MEL. The PARTIAL-OPEN position is when the main flap of the valve is closed and the auxiliary flap is OPEN. This will allow for smoke removal in case of avionics smoke in flight. The valve is equipped with a handle which is used to crank the valve open or closed. When the Skin Air Outlet Valve is deactivated PARTIALLY OPEN, the Skin Exchanger Isolation Valve must be deactivated into the OPEN position.
The Skin Exchanger Isolation Valve is located in the avionics compartment. The valve is equipped with a manual lever/position indicator which may be used to put the valve in the OPEN position.
Procedure:
- push latch to release the handle from the valve,
- pull the handle to engage the splines,
- set the Deactivation switch to OFF,
- turn the handle clockwise until the main flap is closed and the auxiliary flap is OPEN,
- stow and latch the handle,
- disconnect the electrical connector of the Skin Exchanger Isolation Valve and move the manual override handle to the OPEN position,
- perform AEVC BITE.

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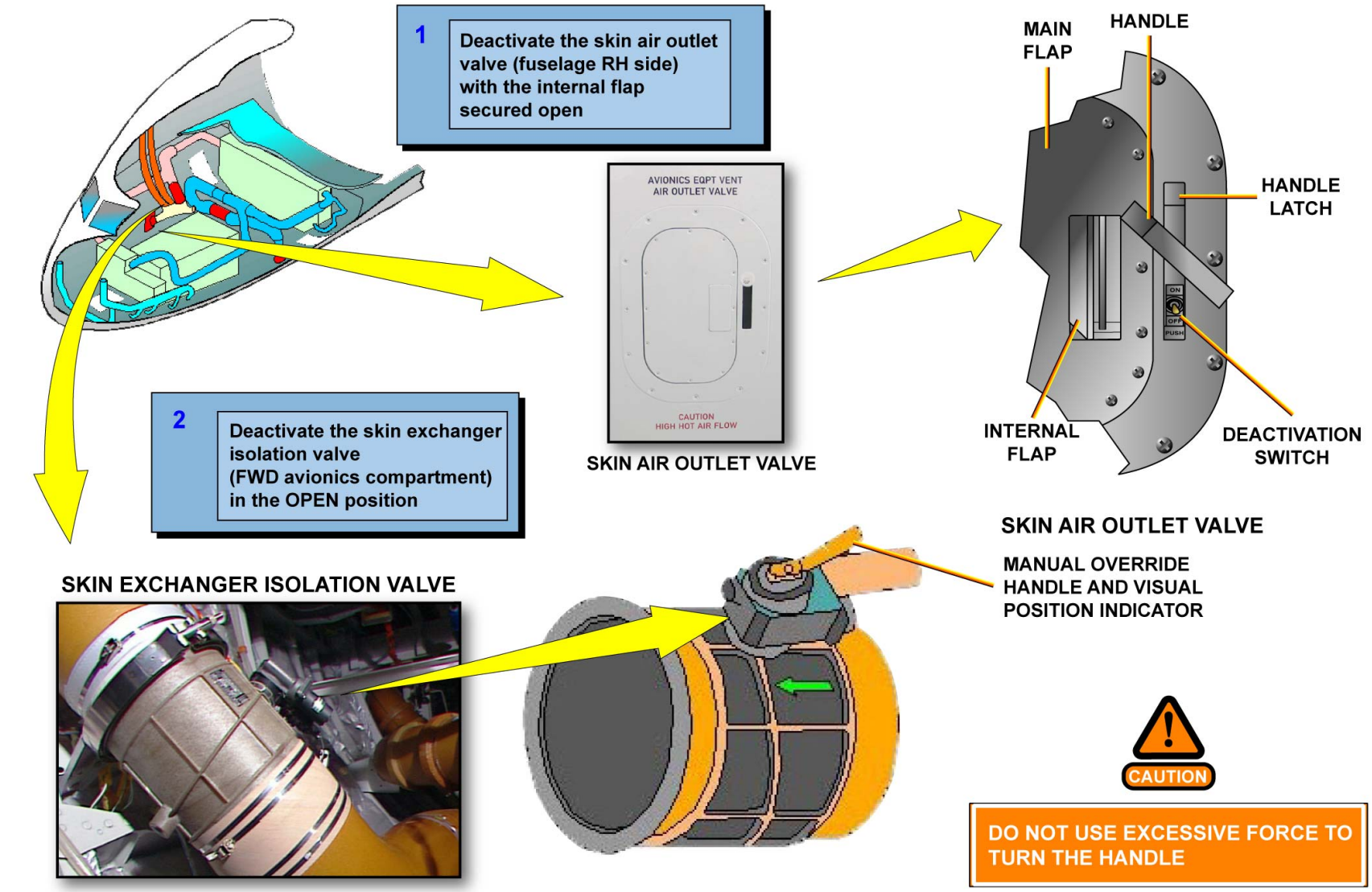
1
Deactivate the skin air outlet valve (fuselage RH side) with the internal flap secured open
AVIONICS EQPT VENT
AIR OUTLET VALVE
CAUTION
HIGH HOT AIR FLOW
SKIN AIR OUTLET VALVE
MAIN FLAP
HANDLE
HANDLE LATCH
INTERNAL FLAP
DEACTIVATION SWITCH
2
Deactivate the skin exchanger isolation valve (FWD avionics compartment) in the OPEN position
SKIN EXCHANGER ISOLATION VALVE
SKIN AIR OUTLET VALVE
MANUAL OVERRIDE HANDLE AND VISUAL POSITION INDICATOR
CAUTION
DO NOT USE EXCESSIVE FORCE TO TURN THE HANDLE

MEL/DEACTIVATION - AVIONICS VENTILATION SKIN AIR OUTLET VALVE

AIR CONDITIONING SYSTEM LINE MAINTENANCE (2)

MEL/DEACTIVATION (continued)

AVIONICS VENTILATION SKIN AIR INLET VALVE

In case of failure, the Skin Air Inlet Valve may be deactivated in the CLOSED position for dispatch per the MEL. The valve is equipped with a handle which is used to crank the valve open or closed. When the Skin Air Inlet Valve is deactivated CLOSED, the Conditioned Air Inlet Valve must be deactivated to the OPEN position. This allows supplemental cooling from the cockpit air conditioning supply for the avionics equipment when the normal supply is affected.
The conditioned air inlet valve is located in the avionics compartment. The valve is equipped with a manual lever/position indicator which may be used to put the valve in the OPEN position.
Deactivation procedure:
- push latch to release the handle from the valve,
- pull the handle to engage the splines,
- set the Deactivation switch to OFF,
- turn the handle counter-clockwise until the flap is closed,
- stow and latch the handle,
- remove the electrical connector from the Conditioned Air Inlet Valve and move the manual override handle to the OPEN position,
- perform AEVC BITE.

AVIONICS VENTILATION CONDITIONED AIR INLET VALVE

In addition to the Skin Air Inlet Valve deactivation, other ventilation system deactivation tasks also include deactivation of the Conditioned Air Inlet Valve in the OPEN position. These affected components are:
- the blower fan,
- the extract fan,
- the ventilation filter.

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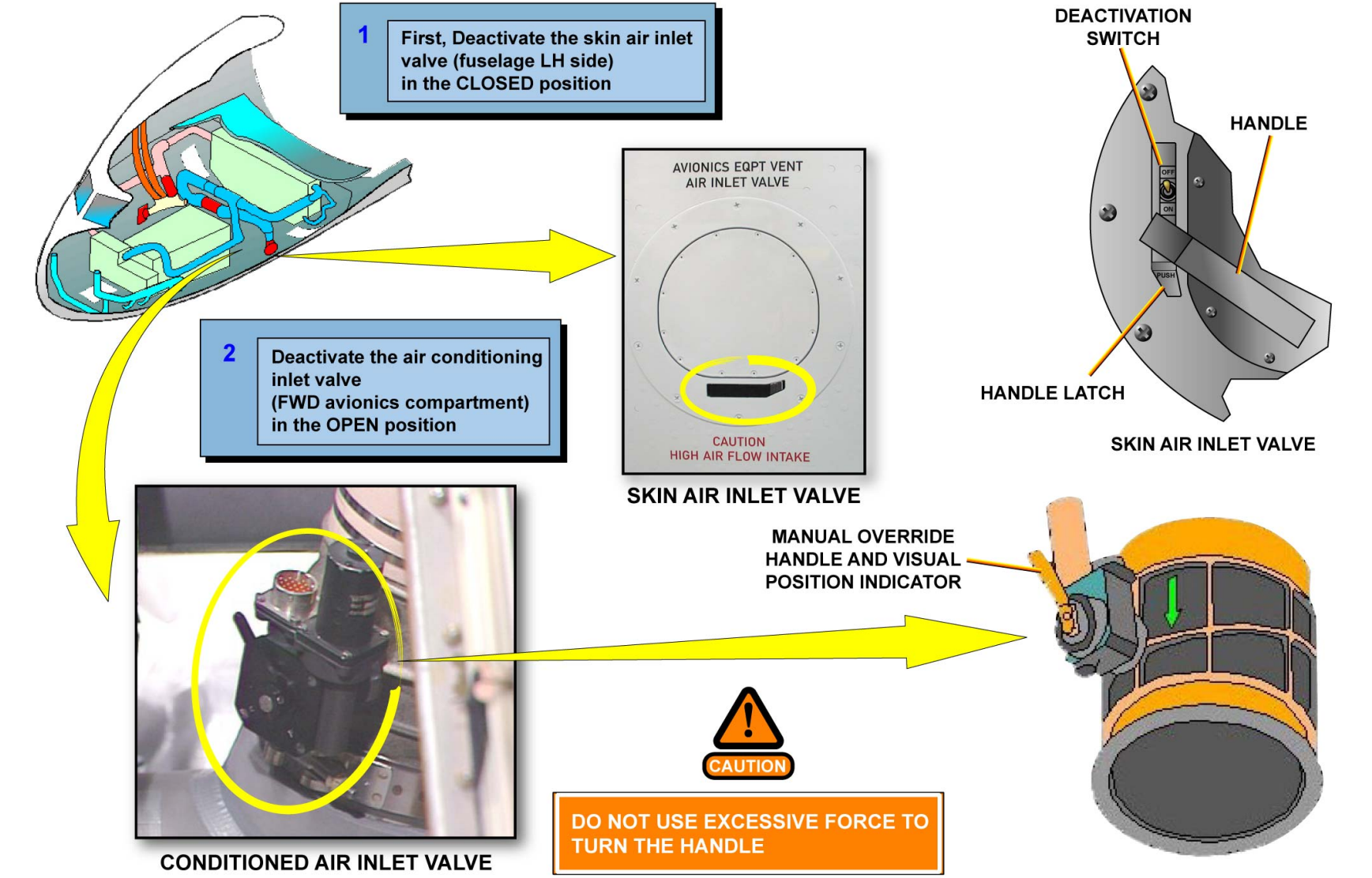
1
First, Deactivate the skin air inlet valve (fuselage LH side) in the CLOSED position
2
Deactivate the air conditioning inlet valve (FWD avionics compartment) in the OPEN position
AVIONICS EQPT VENT
AIR INLET VALVE
CAUTION
HIGH AIR FLOW INTAKE
SKIN AIR INLET VALVE
DEACTIVATION SWITCH
HANDLE
HANDLE LATCH
SKIN AIR INLET VALVE
CONDITIONED AIR INLET VALVE
MANUAL OVERRIDE HANDLE AND VISUAL POSITION INDICATOR
CAUTION
DO NOT USE EXCESSIVE FORCE TO TURN THE HANDLE

MEL/DEACTIVATION - AVIONICS VENTILATION SKIN AIR INLET VALVE & AVIONICS VENTILATION CONDITIONED AIR INLET VALVE

AIR CONDITIONING SYSTEM LINE MAINTENANCE (2)

MAINTENANCE TIPS

When the aircraft is on the ground with the electrical systems powered, the avionics ventilation system is normally in the OPEN configuration. In this configuration, the ventilation BLOWER fan pulls air in from the open Skin Air Inlet Valve on the LH side of the fuselage. The air is circulated through the ventilation system and then the EXTRACTION fan discharges the air overboard through the open Skin Air Outlet Valve. If maintenance is being performed on the aircraft in heavy rain conditions with the ventilation system in the OPEN configuration, the blower fan may draw water into the ventilation system and subsequently, into the aircraft computers. To prevent water ingestion, the ventilation system should be put in the CLOSED configuration by selecting the EXTRACT pushbutton to OverRriDe (OVRD) on the VENTILATION panel. For additional cooling in the CLOSED configuration, select the packs ON. If the Skin Air INLET or OUTLET valve fails on the ground and no replacement part is available, either valve may be manually operated to the OPEN position. This will allow cooling for the avionics equipment if the aircraft is powered for maintenance operations. Before flight, the failed valve must be deactivated in the proper configuration.

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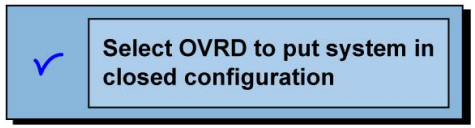
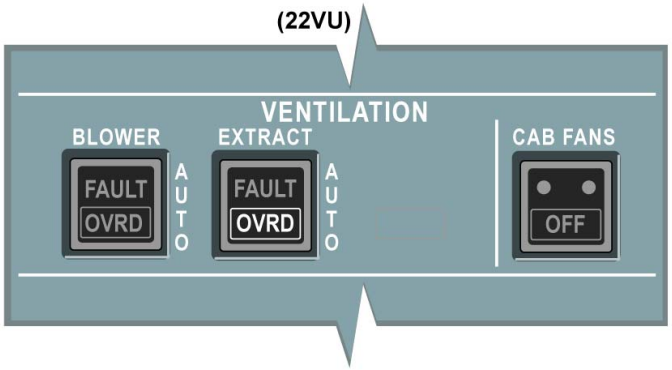
SKIN AIR INLET VALVE

SKIN AIR OUTLET VALVE





MAINTENANCE TIPS

AIR CONDITIONING SYSTEM OPERATION, CONTROL & INDICATING (3)

AIR CONDITIONING SUB-SYSTEMS

PACK 1 OVERHEAT

CABIN / COCKPIT DUCT OVERHEAT

VENTILATION SUB-SYSTEMS

VENT EXTRACT FAULT

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